U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
PB-286 285

Computer Assisted Area Source Emissions (CAASE) Gridding Procedure (Revised) IBM 370/OS Version User's Manual

(U.S.) Research Triangle Inst, Research Triangle Park, NC

Prepared for

Environmental Protection Agency, Research Triangle Park, NC Office of Air Quality Planning and Standards

Mar 78

PB 286 285

EPA-450/3-78-009
March 1978

COMPUTER ASSISTED AREA SOURCE EMISSIONS (CAASE) GRIDDING PROCEDURE (REVISED)

IBM 370/OS VERSION USER'S MANUAL

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-450/3-78-009	2.	3. RECIPIENT'S ACCESSION NO. PB-286 285
4. TITLE AND SUBTITLE Computer Assisted Area Source Emissions (CAASE) Gridding Procedure (Revised) IBM 370/OS Version User's Manual		5. REPORT DATE March 1978
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Richard Haws J. W. Dunn, III		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Research Triangle Institute Research Triangle Park, North Carolina 27709		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO. 68-02-2501
12. SPONSORING AGENCY NAME AND ADDRESS Environmental Protection Agency Research Triangle Park, North Carolina 27711		13. TYPE OF REPORT AND PERIOD COVERED Final Report - March 1978
		14. SPONSORING AGENCY CODE 200/04

15. SUPPLEMENTARY NOTES

16. ABSTRACT

Atmospheric dispersion modeling programs such as the Climatological Dispersion Model (CDM), Air Quality Display Model (AQDM), and Implementation Planning Program (IPP) are among the most basic tools used for evaluation of air quality and State Implementation Plans (SIP's). Since emissions data comprise the most important input information for these models, any factor affecting the availability and completeness of the emissions data has a significant impact on the results of the modeling programs. Procedures for formatting emissions from point sources are well defined, however area source emission data present problems. Usually the smallest geographic unit for which accurate primary data are available is the county. These data must be disaggregated and appropriately allocated to smaller areas to provide an adequately detailed input.

The Computer Assisted Area Source Emissions gridding programs with associated subroutines containing automated gridding procedures provide an objective method for allocating county-level data to grid squares selected on the basis of demographic features and sized to give appropriate detail for input to air quality modeling programs.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Modeling Area Sources Emissions Gridding		

18. DISTRIBUTION STATEMENT Release Unlimited	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 468
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE PcA20 mfA01

EPA Form 2220-1 (9-73)

ATTENTION

AS NOTED IN THE NTIS ANNOUNCEMENT,
PORTIONS OF THIS REPORT ARE NOT LEGIBLE.
HOWEVER, IT IS THE BEST REPRODUCTION
AVAILABLE FROM THE COPY SENT TO NTIS.

EPA-450/3-78-009

COMPUTER ASSISTED AREA SOURCE EMISSIONS (CAASE) GRIDDING PROCEDURE (REVISED)

IBM 370/OS VERSION USER'S MANUAL

by

Richard C. Haws and J.W. Dunn, III

Research Triangle Institute
Research Triangle Park, North Carolina 27709

Contract No. 68-02-2501

EPA Project Officer: Jerome B. Mersch

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

March 1978

This report is issued by the Environmental Protection Agency to report technical data of interest to a limited number of readers. Copies are available free of charge to Federal employees, current contractors and grantees, and nonprofit organizations - in limited quantities - from the Library Services Office (MD-35), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711; or, for a fee, from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.

This report was furnished to the Environmental Protection Agency by the Research Triangle Institute, Research Triangle Park, North Carolina 27709, in fulfillment of Contract No. 68-02-2501. The contents of this report are reproduced herein as received from the Research Triangle Institute. The opinions, findings, and conclusions expressed are those of the author and not necessarily those of the Environmental Protection Agency. Mention of company or product names is not to be considered as an endorsement by the Environmental Protection Agency.

Publication No. EPA-450/3-78-009

ACKNOWLEDGEMENT

This revision to the manual was prepared by the Research Triangle Institute, Research Triangle Park, North Carolina, for the Environmental Protection Agency under Contract 68-02-2501. The research is under the direction of personnel in the Source Receptor Analysis Branch (SRAB).

The work has been carried out under the direction of Mr. Jerome B. Mersch, who is the EPA Project Officer for the contract.

RTI staff members principally participating in developing the system and applying it are as follows:

E. L. Hill, Laboratory Supervisor
R. C. Haws, Project Leader
H. L. Hamilton, Jr., Consultant and Co-developer of the earlier CAASE methods
D. H. Abbott, Programmer
S. K. Burt, Programmer
J. W. Dunn III, Mathematician
R. E. Paddock, Systems Analyst

TABLE OF CONTENTS

Page Number

ACKNOWLEDGEMENT iii

FIGURES ix

TABLES xii

1.0 INTRODUCTION 1

  1.1 General Background 1

  1.2 Purpose 6

  1.3 The CAASE Method 8

2.0 CAASE1 PROGRAM 19

  2.1 Program Description 19

  2.2 Input Information 22

  2.3 Output Information 26

  2.4 Job Control Language (JCL) and Deck Setup 31

  2.5 Warnings and Limitations 34

3.0 CAASE2 PROGRAM 35

  3.1 Program Description 35

  3.2 Input Information 38

  3.3 Output Information 43

  3.4 Job Control Language (JCL) and Deck Setup 49

  3.5 Warnings and Limitations 53

4.0 CAASE3 PROGRAM 59

  4.1 Program Description 59

  4.2 Input Information 60

  4.3 Output Information 60

  4.4 Job Control Language (JCL) and Deck Setup 66

  4.5 Warnings and Limitations 66

Preceding page blank

TABLE OF CONTENTS (CONTINUED)

Page Number

5.0 CAASE4 PROGRAM 71

5.1 Program Description 71

5.2 Input Information 73

5.3 Output Information 77

5.4 Job Control Language (JCL) and Deck Setup 82

5.5 Warnings and Limitations 85

6.0 CAASE5 PROGRAM 87

6.1 Program Description 87

6.2 Input Information 90

6.3 Output Information 92

6.4 Job Control Language (JCL) and Deck Setup 119

6.5 Warnings and Limitations 121

7.0 SUBROUTINE DESCRIPTIONS 125

7.1 CED009 Subroutine 125

7.2 GTGR Subroutine 126

7.3 INBOUN Subroutine 127

7.4 TRACKR Subroutine 128

7.5 REORDR Subroutine 129

7.6 SIDEIT Subroutine 129

7.7 WRAPUP Subroutine 130

7.8 NETBAL Subroutine 130

7.9 DECIDE Subroutine 131

7.10 NTRIOR and FINAL Subroutines 135

TABLE OF CONTENTS (CONTINUED)

Page Number

7.11 PROXPR Subroutine 136

7.12 INPOP Subroutine 136

7.13 PROXML Subroutine 136

7.14 SEARCH and SETLGO Subroutines 137

7.15 TIEBRK Subroutine 137

7.16 GRIDIT Subroutine 137

7.17 ADJUST Subroutine 138

7.18 SQROFF Subroutine 138

7.19 OUTPUT Subroutine 139

7.20 PARTIT Subroutine 139

7.21 DELETE Subroutine 139

7.22 INTEGR Subroutine 139

7.23 ASTORE and NSTORE Subroutines 139

7.24 YOFX and XOFY Subroutines 140

7.25 FAREA Subroutine 141

7.26 SORT Subroutine 141

7.27 POPBOX Subroutine 141

7.28 EDPLOT Subroutine 142

7.29 COOUT Subroutine 142

7.30 READ1 Subroutine 142

7.31 OUTPT1 Subroutine 143

7.32 OUTPT2 Subroutine 143

7.33 OUTPT3 Subroutine 143

TABLE OF CONTENTS (CONTINUED)

Page Number

8.0 OBJECTIVE APPORTIONING FACTORS AND SUBJECTIVE OVERRIDING WEIGHTING FACTORS. 145

APPENDIX A: LOGICAL FLOWCHARTS AND FORTRAN SOURCE CODE LISTINGS - CAASE1 (and Subroutines). A-1

APPENDIX B: LOGICAL FLOWCHARTS AND FORTRAN SOURCE CODE LISTINGS - CAASE2 (and Subroutines). B-1

APPENDIX C: LOGICAL FLOWCHARTS AND FORTRAN SOURCE CODE LISTINGS - CAASE3 (and Subroutines). C-1

APPENDIX D: LOGICAL FLOWCHARTS AND FORTRAN SOURCE CODE LISTINGS - CAASE4 (and Subroutines). D-1

APPENDIX E: LOGICAL FLOWCHARTS AND FORTRAN SOURCE CODE LISTINGS - CAASE5 (and Subroutines). E-1

APPENDIX F: GTGR TABLES AND FORTRAN SOURCE CODE LISTINGS - DIRECT ACCESS FILE CREATION PROGRAM. F-1

FIGURES

Number		Page Number
1	Flowchart of the Overall CAASE System	9
2	System Flowchart of CAASE1 Program	23
3	Input Deck Configuration for CAASE1 Program	27
4	Example of Printed Output from CAASE1	29
5	JCL and Input Data Cards for CAASE1	33
6	System Flowchart of CAASE2 Program	39
7	Input Deck Configuration for CAASE2 Program	41
8	Example of Printed Output from CAASE2	44
9	JCL and Input Data Cards for CAASE2	51
10	System Flowchart of CAASE3 Program	60
11	Input Deck Configuration for CAASE3 Program	63
12	Example of Plotter Output from CAASE3	65
13	Example of Printed Output from CAASE3	67
14	JCL and Input Data Cards for CAASE3	68
15	System Flowchart of CAASE4 Program	75
16	Input Deck Configuration for CAASE4 Program	78
17	Example of Printed Output from CAASE4	80
18	Example of Optional Detailed Printout of Apportioning Factors, Etc., from CAASE4	81
19	JCL and Input Data Cards for CAASE4	84
20	System Flowchart of CAASE5 Program	91
21	NEDS Area Source Input Form for Washington County, Ohio (1972)	93
22	Scaled Area Source Emission Factors Used as Input to CAASE5 for the CAASE Examples	94

FIGURES

Number		Page Number
23	Input Deck Configuration for CAASE5 Program	96
24	Example Printout of Area Source Input Data, CAASE5 . . .	100
25	Example of CAASE5 Output Table 1, Allocated Fuels	102
26	Example of CAASE5 Output Table 2, Allocated Fuels	103
27	Example of CAASE5 Output Table 3, Allocated Fuels	104
28	Example of CAASE5 Output Table 4, Allocated Fuels	105
29	Example of CAASE5 Output Table 5, Allocated Fuels	106
30	Example of CAASE5 Output Table 1, Allocated Emissions, Particulates	107
31	Example of CAASE5 Output Table 2, Allocated Emissions, Particulates	108
32	Example of CAASE5 Output Table 3, Allocated Emissions, Particulates	109
33	Example of CAASE5 Output Table 4, Allocated Emissions, Particulates	110
34	Example of CAASE5 Output Table 5, Allocated Emissions, Particulates	111
35	Example Printout of County Total Emissions for All Source Category and Pollutant Combinations, CAASE5 . .	112
36	Example Printout of Dispersion Model Input Card Images, CAASE5, IPP Model	113
37	JCL and Input Card Example for CAASE5	120
38	Cell (i,j), Portions of the Adjoining Cells, and the Eight Combinations of Δx,Δy for Exiting Side Number 1	131

FIGURES

Number | | Page Number

39 Area Under a Line Segment 141

40 Examples of Overriding Weighting Factors Assignments
for Railway Locomotive Operations

-A Example of Railway Locomotive Weighting Factor of 1.0 (2 Km X 2 Km Grid Square) 153

-B Example of Railway Locomotive Weighting Factor of 2.0 153

-C Example of Railway Locomotive Weighting Factor of 1.0 (4 Km X 4 Km Grid Square) 154

-D Example of Railway Locomotive Weighting Factor of 0.5 154

-E Example of Railway Locomotive Weighting Factor of 3.21 154

TABLES

Number Page Number

1 Input Card Layout, CAASE1 24

2 Record Layout for MED-X Census File 28

3 Record Layout for Edited MED-X File 32

4 Input Card Layout, CAASE2 40

5 CAASE2 County Outline File Record Layout 42

6 Format of Card Image Records Output from CAASE2 47

7 Definitions for Variables Output from CAASE2
as Card Images 48

8 Record Layout for CAASE2 Optional County Outlines
Output File 50

9 Variables Defined in CAASE2 Main Calling Program 55

10 Input Card Layout, CAASE3 62

11 CAASE3 County Outline File Record Layout 64

12 Area Source Emissions Category Numbers 74

13 Input Card Layout, CAASE4 76

14 Output Record Layout for Apportioning Factor
File, CAASE4 83

15 Input Card Layout, CAASE5 97

16 Output Tape Record Layout for CAASE5 114

17 Definitions of CAASE5 Output Tape Variables 116

18 Increment Matrix

-a i-Increment, Exit Side 1 132

-b j-Increment, Exit Side 1 132

19 Entry Side of Cell; Exit Side 1 134

TABLES

Number | Page Number

20 Summary of Cell Index Increment Matrices and Entry Side Matrices to be Used Under Conditions of Single Side Exit or Corner Exit for Specified Sides or Corners 135

21 "New" Area Source Emissions Category Numbers and Their Objective Apportioning Factor 147

1.0 INTRODUCTION

1.1 General Background

The attainment and maintenance of acceptable air quality within an Air Quality Control Region (AQCR) or an Air Quality Maintenance Area (AQMA) requires the implementation of appropriate strategies to control the emission of pollutants from individual sources or classes of sources. The probable success of candidate control strategies can be evaluated through the use of computer simulation models. These models manipulate source characteristics and meteorological conditions to produce a distribution of ambient air pollutant concentrations over the region being considered.

Simulation models frequently used are based on Gaussian plume formations and accept as input point and/or area sources. Point sources are individually identifiable stacks, process vents, etc., emitting more than some arbitrarily specified mass of pollutant each year. Area sources, however, include the more ubiquitous, individually small sources which cannot be specifically located.

The objective of the Computer Assisted Area Source Emissions (CAASE) gridding method is to improve the characterization of area sources. Basic data for the determination of area source emissions are rarely available for geographic or political units or areas smaller than the county. Such basic data are in the form of annual fuel consumption by fuel type for residential, commercial, institutional, and industrial heating; acreage burned by forest wildfires; landing-takeoff cycles for military, commercial, and civil aircraft; gasoline or diesel fuel consumed by light, heavy, and off-highway vehicles, or vehicle miles traveled by road classification, etc. These data can be converted to pollutant emissions by the application of appropriate emission factors.

The geographic size of a county, however, is too large for practical use in simulation models for AQCR's or AQMA's. Logical procedures are required to distribute the county totals of basic data or derived emissions data to smaller areas. Further constraints imposed by simulation models require that these small areas be squares, althougn they need not be of uniform size. Various criteria have been proposed for the selection of sizes and the distribution of emission area squares. Urbanization, land use, housing counts, and population have all been used subjectively to grid AQCR's and AQMA's into emission area squares (hereafter called grid squares) and subsequently to allocate county totals of pollutant emissions into each grid square. In general, the philosophy followed has required that urbanized or industrialized portions of a county or study area be gridded into small squares to provide for detailed representation of pollution sources. Conversely, rural areas with few pollution sources are adequately represented by larger grid squares. Essentially, application of this philosophy results in apportioning county total emissions to grid squares according to subjective estimates of the distribution of population. Since air pollution derives from human activity, this procedure provides a reasonable approach to developing area source emission distributions.

The development of the CAASE programs began as an effort to reduce the subjectivity inherent in distributing population into preselected grid squares. Success in this effort would reduce the time and effort required to complete the area source emission distribution.

The Bureau of the Census of the U.S. Department of Commerce has prepared a modified Master Enumeration District List (MEDList) which includes, in addition to the district identification, population count, housing count, etc., the geographic coordinates of the center of area of each of the enumeration districts.

The procedures described in this manual have evolved from a feasibility study (Contract CPA 70-147) in which three AQCR's, 145 (Lancaster, Gage, and Jefferson Counties, Nebraska), 99 (South Central, Kansas), and 130 (Metropolitan Fargo-Moorehead) were gridded. In this study, the ambient air quality indicated by the Air Quality Display Model (AQDM) simulation model, based on a previously prepared (by another EPA contractor) source emissions grid and a corresponding simulation based on the CAASE grid were compared. Because smaller grid squares were used by the CAASE method for central urban areas - where the plotted population data showed concentrations of people - higher peak values of ambient pollutant concentrations were shown for the cities, and sharper gradients of pollutant concentrations appeared in the urban-to-rural transition zone. In rural areas, ambient pollutant concentrations did not differ with the change in the grid system.

Subsequent to the demonstration of feasibility of the CAASE method, 15 AQCR's containing 193 counties were gridded, and area source fuels and emissions were determined for each grid square (Contract 68-02-1014). This resulted in the writing of a User's Manual.* The programs, together with the User's Manual, were then made available by EPA to air pollution control agencies and contractors engaged in dispersion modeling.

In the earlier CAASE method, i.e., before this major revision, a computer drawn plot of the population centers was used in conjunction with the U.S. Geological Survey (USGS) maps to construct a study area grid square system. For each population center, a circle, with its radius proportional to population count, was drawn. Each grid square was assigned to only one county for subsequent emissions apportioning purposes; the user had to take this into consideration when constructing grid squares near county borders. A description of the resulting grid network was then used by CAASE in subsequent steps. Procedurally, the Universal Transverse Mercator (UTM) coordinates of the lower left hand corner of each grid square, its side length, a sequential identification number, state name, and county name were entered on keypunch load sheets. These data were then keypunched and verified. In subsequent steps, all population and housing counts for an enumeration district (ED) were assigned to the grid square in which the geographic coordinates of the center of the ED were located. This was done because the contained area and configuration of each ED was not available for computer use. Therefore, some grid squares did not have census count data assigned to them and, accordingly, no fuels or emissions were apportioned to these "empty" grid squares. Although the dispersion modeling results using these data were similar to those using data processed by more tedious, subjective, and time-consuming methods, some potential CAASE users were concerned about the "empty" grid squares and were hesitant to use CAASE.

---

* Computer Assisted Area Source Emissions Gridding Procedure (CAASE) User's Manual, EPA-450/3-74-034, January 1974.

As stated above, each grid square was assigned to only one county. The assignment of apportioning factors by CAASE4 and the allocation of fuels and emissions by CAASE5 was done on a county-by-county basis. The grid squares assigned to a county were the only grid squares used when processing that county. This procedure resulted in some of the population and housing counts not being used after the grid square network had been constructed. The apportioning factor program (CAASE4) read a census enumeration district record and searched the array of grid squares assigned to the county to determine the grid square containing the enumeration district's location coordinates. When the grid square was found, the population and housing counts were added to the sums for that grid square. In some cases, no grid square was found that contained the enumeration district's coordinates because the grid square containing them had been subjectively assigned to another county. (Population and area were used along with the location of county boundaries when a grid square was assigned to a county.)

Although the apportioning factor program (CAASE4) permitted the user to input subjectively derived weighting factors to modify the objective ones calculated by the program, it still involved a large amount of data preparation time. An entry had to be prepared for each grid-square-source-category combination that the user wanted overridden.

The early CAASE method did not contain a technique for including projected population changes directly.

Since the earlier CAASE method was developed, a computerized data base* has been made available that includes the geographic coordinates of straight line segments approximating the county boundaries for all counties in the contiguous United States. This data base made it possible to objectively determine the location of a grid square in relation to a county. For instance, is it entirely within one county or do county borders transect it, and if it is located on a border or borders, what fraction of its area is located in each county?

The new CAASE methods and algorithms described in this manual incorporate the optional projection of population and housing count data. The new algorithms also include the objective (automatic) computer gridding of the study area including the assignment of population and housing counts to grid squares from each county census in proportion to the area of the grid square within each county. Since a proximal mapping technique is used (see Section 3), housing and population are assigned to all grid squares in the resulting grid system; i.e., there are no "empty" squares.

---

* U.S. Bureau of the Census, DIME County Outline File (DIMECO).

In the earlier CAASE method, census data was plotted by CAASE2 to assist in the manual development of the grid square network. The new CAASE2 program uses mathematical techniques to automatically develop the grid square network. The earlier version of the CAASE3 program used a line drawing plotter to draw the grid square network. All line drawing plotter functions have been incorporated within the revised CAASE3 program which is optional. CAASE3 will now optionally plot the census data and the county boundaries in addition to drawing the grid.

1.2 Purpose

Emissions inventory data for all designated primary pollutants are collected for the entire United States. These data are archived by the agencies compiling the inventory and are also sent to the Environmental Protection Agency (EPA) for inclusion in the National Emissions Data System (NEDS). For dispersion modeling, the emissions inventory data must be in a suitable format for the model selected. Atmospheric dispersion models (computer programs) are used for displaying air quality, evaluating state implementation plans (SIPs), and Air Quality Maintenance Area (AQMA) planning and analysis. Key atmospheric dispersion models include the Air Quality Display Model (AQDM), the Implementation Planning Program (IPP), and the Climatalogical Dispersion Model (CDM).

Point source emissions present few difficulties with regard to formatting the data for use with AQDM, IPP, or CDM. Area source emissions, however, present problems. The smallest geographic unit for which accurate primary data (e.g., annual residential fuel consumption) are available is usually the county. Such data must be disaggregated and appropriately allocated (as emissions) to smaller areas to provide an adequately detailed input to dispersion models.

The CAASE programs (CAASE1 through CAASE5), with associated subroutines and data bases, provide an objective method for the selection of a set of non-uniform sized grid squares and the subsequent allocation of county-level data.

The automatic gridding features of the revised CAASE method use objective factors of population density, housing density, and political (county) geographic boundaries for selecting a grid-square network.

The revised CAASE method described in this manual provides for the optional manipulation of the Bureau of the Census data for projected changes in population and housing since the last census count (and into the future). The CAASE user can describe a population and/or housing change area by the input of geographic location coordinates of a rectangle (of any size) and growth coefficients, one for population counts and one for housing counts. These coefficients are applied directly to any enumeration district centers that are located within the rectangle. A 0.8 coefficient would indicate a 20% reduction whereas a 1.2 coefficient would indicate a 20% increase. The user can input up to 100 rectangles with associated coordinates and growth coefficients.

The CAASE user can optionally define up to 100 pseudo-enumeration districts* and associated population and housing counts where development is planned or has taken place since the last general census.

---

*This term is used herein in the context that the user inputs housing and population counts and associated location data (coordinates, state and county identification) for a place that is not the center of a true Bureau of the Census enumeration district. CAASE deals with these pseudo EDs as if they were true EDs.

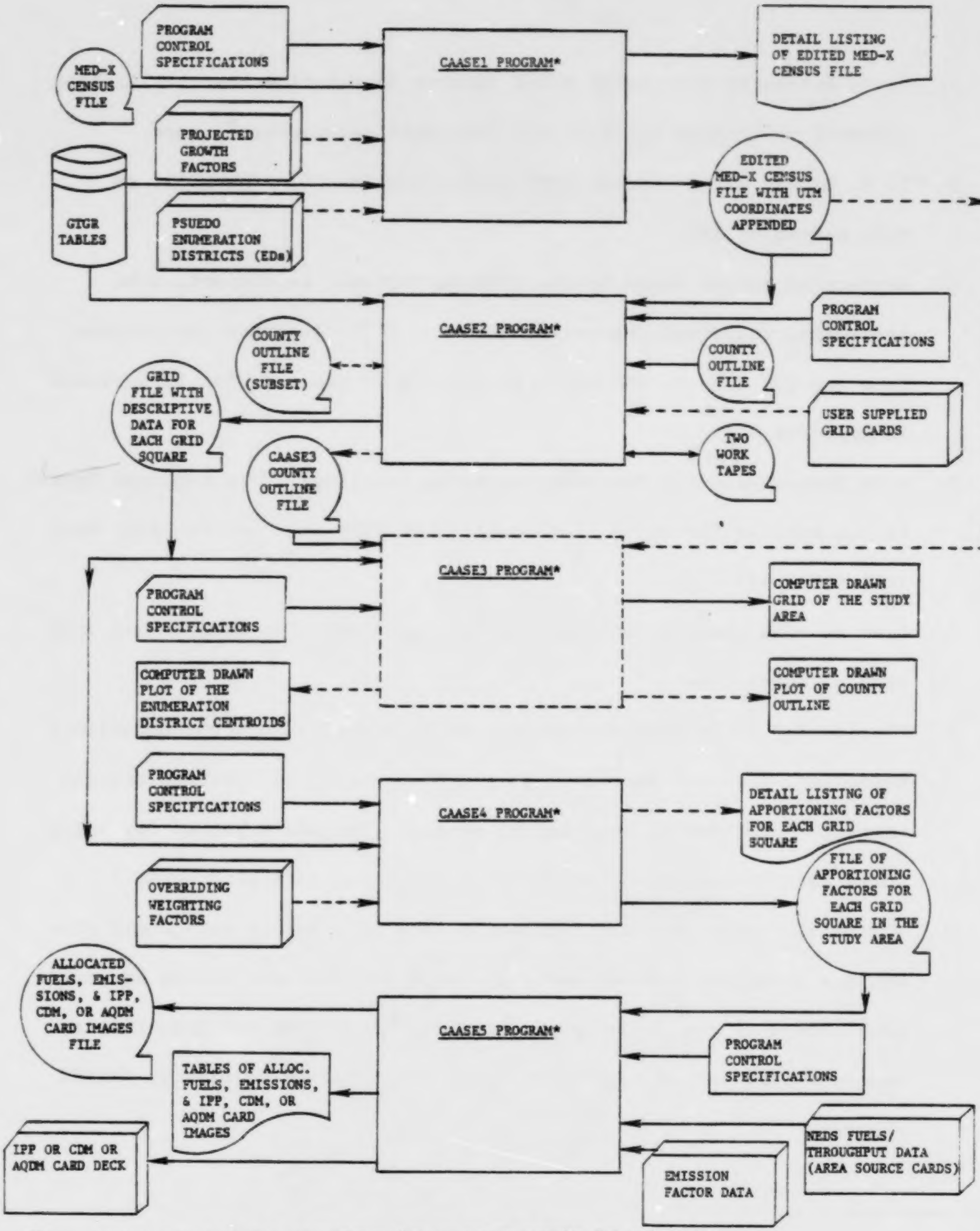
These two census manipulation features, when combined with a projection of fuels used within a county, provide a valuable tool to the user in applying simulation modeling to prepare or evaluate Air Quality Maintenance Plans. Such plans can span from the present time to up to ten (or more) years in the future.

1.3 The CAASE Method

CAASE is a computerized technique for processing county-level primary fuels and emissions data from area source emission categories. CAASE automatically developes a set of non-uniform sized sub-county grid squares for a geographic study area. CAASE then allocates fuels data to the grid squares. CAASE calculates emission totals, by county, and allocates emissions to the grid squares automatically, using either totally objective apportioning factors, or a combination of objective and user-provided overriding weighting factors. CAASE produces tables of allocated fuels, allocated emissions for the five primary pollutants (TSP, SO_2, NO_X, HC, and CO), and atmospheric dispersion model input card images, in a user-selected format, for one of three dispersion models. The tabular output includes data for every grid square, pollutant, and source category combination. Dispersion model input card formats produced by CAASE are formatted for input to the Air Quality Display Model (AQDM), the Implementation Planning Program (IPP), or the Climatalogical Dispersion Model (CDM).

CAASE consists of five major computer programs including various subroutines called by these programs. For convenience, the programs have been numbered CAASE1 through CAASE5. The programs and their use are discussed in Sections 2 through 6; subroutines are discussed separately in Section 7.

Figure 1 is a flowchart of the overall CAASE system. Sections 2 through 6 contain system flowcharts for each of the major programs. Detailed flowcharts and source language listings for all CAASE programs and subroutines are included in the Appendixes.


PROGRAM CONTROL SPECIFICATIONS
MED-X CENSUS FILE
PROJECTED GROWTH FACTORS
GTGR TABLES
PSUEDO ENUMERATION DISTRICTS (EDs)
CAASE1 PROGRAM*
DETAIL LISTING OF EDITED MED-X CENSUS FILE
EDITED MED-X CENSUS FILE WITH UTM COORDINATES APPENDED
CAASE2 PROGRAM*
COUNTY OUTLINE FILE (SUBSET)
GRID FILE WITH DESCRIPTIVE DATA FOR EACH GRID SQUARE
CAASE3 COUNTY OUTLINE FILE
PROGRAM CONTROL SPECIFICATIONS
COUNTY OUTLINE FILE
USER SUPPLIED GRID CARDS
TWO WORK TAPES
CAASE3 PROGRAM*
PROGRAM CONTROL SPECIFICATIONS
COMPUTER DRAWN PLOT OF THE ENUMERATION DISTRICT CENTROIDS
COMPUTER DRAWN GRID OF THE STUDY AREA
COMPUTER DRAWN PLOT OF COUNTY OUTLINE
PROGRAM CONTROL SPECIFICATIONS
CAASE4 PROGRAM*
DETAIL LISTING OF APPORTIONING FACTORS FOR EACH GRID SQUARE
OVERRIDING WEIGHTING FACTORS
FILE OF APPORTIONING FACTORS FOR EACH GRID SQUARE IN THE STUDY AREA
ALLOCATED FUELS, EMISSIONS, & IPP, CDM, OR AQDM CARD IMAGES FILE
CAASE5 PROGRAM*
PROGRAM CONTROL SPECIFICATIONS
TABLES OF ALLOC. FUELS, EMISSIONS, & IPP, CDM, OR AQDM CARD IMAGES
IPP OR CDM OR AQDM CARD DECK
EMISSION FACTOR DATA
NEDS FUELS/ THROUGHPUT DATA (AREA SOURCE CARDS)

*Error messages are output when appropriate; also see output examples for each program.

---- = Optional

FIGURE 1. FLOWCHART OF THE OVERALL CAASE SYSTEM

In addition to maps for the study area, the CAASE user needs the following data.

A. U. S. Bureau of the Census MED-X (Master Enumeration District Listing extended to include latitude and longitude coordinates[*]) tape.

B. U. S. Bureau of the Census DIME County Outline File (DIMECO), as reformatted by EPA.

C. Conversion tables (used by the GTGR subroutine) to convert, when necessary, Universal Transverse Mercator (UTM) location coordinates from one UTM zone to another. (A listing of these tables is included in Appendix F.)

D. Area Source Data for the counties being processed. The required format is the same as for cards A1 through A5 on NEDS Area Source Input Form [EPA (DUR) 219 3/72].

E. Current stationary source and mobile source emission factors for area source categories.

F. (Optional.) If population and housing data are to be projected (i.e., modified), the user must provide growth factors and location coordinates for new housing development areas. (The CAASE method for using these data is described in detail in Section 2, CAASE1 Program.)

G. (Optional.) The user can optionally read in a set of sub-county grid squares developed independently of CAASE or developed during an earlier CAASE computer run. (The procedures for formatting and inputting a user-supplied set of grid squares are described in Section 3, CAASE2 Program.)

---

[*] These coordinates are for the centroid of the enumeration district, the area of the enumeration district is not available on this tape.

H. (Optional.) The user can optionally override any of the sub-county apportioning factors calculated by CAASE. These overriding weighting factors are input on cards. (Section 8 discusses procedures to follow for the assignment of overriding weighting factors; Section 5 details their input formats and their position in the card input stream.)

The following paragraphs present an overview of the functions performed by each of the CAASE programs.

The CAASE1 program processes the census data. State and county selector cards are used to select a subset of the census data for the geographic area being processed.

The user can optionally define areas of population and housing growth. Each growth area is described by the lower left hand coordinates and the side lengths of a rectangle. A growth factor coefficient for housing contained in the rectangle and also a growth factor coefficient for population are provided by the user. Any census enumeration district centroids located within a growth rectangle will have the associated coefficients applied. For example, a housing count coefficient of 1.25 would represent a 25% increase in housing count since the date of the housing count included on the MED-X tape.

The program also permits the user to include pseudo-enumeration districts for more localized growth areas. For CAASE purposes, a pseudo-enumeration district is defined herein as user-provided inputs of housing and population counts and associated location data (coordinates, state and county identification) for a place that is not the center of a true Bureau of the Census enumeration district. A new housing development, for example, could be treated as a pseudo-enumeration district.

CAASE1 flags each enumeration district record as being unmodified, growth factor applied, or a pseudo-enumeration district. These flags are later used by CAASE3 for plotting symbol selection if the data are to be plotted.

CAASE1 also converts the latitude and longitude coordinates of each selected enumeration district (from the MED-X tape) to UTM coordinates. If the study area includes data from more than one UTM zone,* CAASE1 converts the UTM coordinates to the primary zone selected by the user.

CAASE2 is the automatic gridding program. It computes a system of grid squares over a collection of contiguous counties making up the study area. The grid squares are not necessarily of uniform size but are selected such that each grid square contains approximately the same number of people. Population and housing contained in each grid square is given by the integral of the entire population and housing density surfaces that are contained in the grid square.

For those grid squares that contain area from more than one county, the grid square is assigned to each county that contains a portion of the area of the grid square. Each of the grid squares containing area from more than one county are processed so that a unique sequential identification number, contained area, population, housing, and the state and county FIPS numbers are assigned for each of the counties; for example, a grid square containing area from three counties would be output by CAASE2 as three grid squares where the coordinates of the lower left hand corner of the grid squares and their side lengths would be common - all other attributes would have different numerical values.

The CAASE2 program permits the user the option to input a grid square network. These user-supplied grid squares are then assigned population and housing counts from the CAASE2 population and housing density surfaces. These grid squares may have been developed independently of CAASE. A more obvious use of the user-supplied grid option is when several CAASE runs are being made for an Air Quality Maintenance Area plan spanning several years. If a grid square network had been developed by CAASE2 with "base-year" census data, then there are advantages in using the same grid square network for all years in the study. The CAASE user can project the census data to subsequent years using CAASE1 options, and CAASE2 will assign housing and population counts to a user-provided grid square network. Conversely, if census data is projected using CAASE1 options and a user-supplied grid is not input to CAASE2, the grid square network will probably be redefined based on the projected population and housing density surfaces.

---

*Each UTM zone spans six degrees of longitude in the east-west direction.

CAASE2 optionally outputs a subset of the county outline file in the same format as the input county outline file for efficiency in future runs. CAASE2 also optionally outputs a subset of the county outline file in a format suitable for line drawing plotting using the CAASE3 program.

The CAASE2 computed grid square network is used directly as input by the CAASE4 apportioning factor assignment program. It is also used by the optional CAASE3 program for plotting a scaled grid square network with a line drawing plotter, e.g., a CALCOMP plotter.

The CAASE3 program produces a scaled off-line plotter display of the grid square network output from CAASE2. It will also optionally draw outlines of the county(ies) and/or plot a symbol at the geographic center of each census enumeration district.

The use of CAASE3 is optional but is highly recommended if the user has plotter facilities available. Plotting scale is user-controlled with 1:250,000 having been used in applications thus far. This scale is convenient for using the CAASE3 generated plot as a direct overlay on USGS maps of the study area.

The CAASE4 program calculates apportioning factors for each area source emissions category for each grid square in the study area. (The factors are used by CAASE5 which does the apportioning.) The calculated apportioning factors are the same for both the fuels (throughput) and the emissions. For example, housing counts for each grid square are used to calculate the apportioning factor for both distillate oil marketed for use as residential fuel and the emissions produced by its combustion.

CAASE4 uses census based data and grid square size to calculate apportioning factors for each area source emissions category and grid square combination. This is a totally objective technique that the user may optionally modify. CAASE4 will use overriding factors at the user's option. Most of the area source categories can be apportioned effectively by CAASE4 without user intervention. For a few categories, the user will probably have access to data that is not directly available to CAASE, for example, the locations of airports, waterways, and railroads; for these categories, the user can prepare and input overriding factors.

A detailed description of the CAASE4 method for calculating apportioning factors (with or without user assistance) is included in Sections 5 and 8 of this manual. It is important for the CAASE user to fully understand a basic concept in the calculation of apportioning factors. All of the apportioning factors output from CAASE4 are "weighted apportioning factors." Each one is the product of an objective apportioning factor - for example, grid square contained population - and a weighting factor. The weighting factor is 1.0 unless overridden by the user. The CAASE user does not replace the objective apportioning factors when he uses the overriding option; he modifies the 1.0 (default) weighting factor coefficients of the objective apportioning factors.

The CAASE5 program performs the functions of calculating the emissions and allocating fuels and emissions to each grid square and source category combination.

CAASE5 reads area source fuels (throughput) data for each county in the study area in the same format as the first five cards (A1 through A5) from the NEDS Area Source Input Form [EPA (DUR) 219, 3/72].

Current area source emission factors are input by the user. The factors can be the national emissions factors published by EPA or those developed by state or local agencies. Emission factors for highway motor vehicles are input directly; those for stationary sources and off-highway mobile sources are scaled for input. The scaling of the emission factor takes into account the scaling of the fuels data and units conversion. (A detailed discussion of how to provide emission factors to CAASE5 and an example of a complete input set are included in Section 6.)

CAASE5 uses the fuels (throughput) totals and the emission factors to calculate county-total emissions in the same way as the NEDS programs.

The county totals for fuels and emissions are allocated to each grid square and source category combination using the apportioning factors calculated by CAASE4. The apportioning factor file output from the CAASE4 program is used as direct input to CAASE5.

CAASE5 completely processes one county in the study area before proceeding to the next county.

For each county, CAASE5 produces the following output:

A. Tables of allocated fuels for each grid square and source category combination.

B. Tables of emission totals for the county for each pollutant and source category combination.

C. Tables of allocated emissions for each grid square, pollutant, and source category combination.

D. The county total emissions for each pollutant, i.e., the sum of all area source categories.

E. An atmospheric dispersion model area source input card for each grid square. The required units, scaling, and format for one of three models (IPP, AQDM, or CDM) is selected by the user with an input variable.

F. A formatted tape file containing the above output data elements. (This is not a "print tape"; it is provided as a computer readable data base for those users who may want to process CAASE output in ways other than dispersion modeling. A "print tape" can also be produced easily by changing the definition of the printer in the Job Control Language (JCL) stream.)

The potential CAASE user may decide that CAASE would be helpful for allocating fuels and emissions for most of the source categories, but for one or more of the source categories, CAASE will not provide appropriate allocations. If also, the use of overriding weighting factors will not yield desired results, then there is another way to let CAASE do most of the work. This can be done by manipulating input data to either CAASE4 or CAASE5. In running CAASE4, the user can select a source category to be overridden, initialize all grid squares to zero, and then simply not assign a non-zero value to any of the grid squares for the selected source category. CAASE5 will, therefore, have zero apportioning factors for the source category and will not allocate fuels or calculated emissions. The user can also let CAASE4 routinely calculate apportioning factors for the selected source category. The user can then set the fuels (throughput) total for the selected source category to zero on the NEDS area source input card when CAASE5 is run; the result is that CAASE5 has zero fuels and emissions to allocate for the source category. Any source category fuels and emissions not allocated to grid squares by CAASE could then be allocated manually. For dispersion modeling, any manually allocated emissions would have to be added to the totals output by CAASE5 on the dispersion model input cards.

2.0 CAASE1 PROGRAM

2.1 Program Description

This program processes the census data. It performs several functions: the selection of a data subfile, the conversion of the geographic coordinates of the center of area of each census enumeration district (ED) from latitude and longitude to the Universal Transverse Mercator (UTM) northing and easting system, the optional application of housing and population growth factors, and the optional introduction of pseudo (new) enumeration districts with projected housing and population counts. In those cases where the study area includes data from two UTM zones, one of the zones is designated "primary" on an input card; the UTM coordinates are then converted when necessary to the primary zone. Subsequent CAASE processing of the census data, therefore, uses coordinates expressed relative to only the primary UTM zone.

A description of input information is included in the next subsection. However, the introduction of census growth factors and/or pseudo-enumeration districts, and the selection of a primary UTM zone for those study areas spanning two UTM zones is critical and requires a detailed discussion.

The concept of applying growth coefficients (increase or decrease) over a general area is quite different from the concept of adding a pseudo-enumeration district. In the case of growth coefficients, a rectangle is defined. Any enumeration district having its center of area located within the rectangle will have the user-supplied coefficients of housing and population growth applied to it. A rectangle of growth is defined to CAASE1 by the UTM coordinates of its lower left hand corner and its side lengths. A growth rectangle can be of any size, representing a subsection of the study area or even spanning the entire study area. It would most probably be used in a case where there was general growth in an area.

Preceding page blank

Conversely, the concept of a pseudo-enumeration district is associated with a more localized growth area. The input of a pseudo-enumeration district could be used, for example, to include a new residential housing development either constructed since the last general census count or planned to be developed prior to the projected study year.

In the optional introduction of census data modifications, all location coordinates are expressed in kilometers in the UTM system. (Latitude and longitude coordinates will yield erroneous and unpredictable results.) Because the maps being used would have true UTM zone numbers and coordinates, CAASE1 is programmed to receive true coordinates and zone numbers as user-furnished input. The conversion of coordinates to the primary zone, when necessary, is performed automatically by the program. In those cases where a rectangle of growth straddles a zone boundary, the user should input the coordinates and zone number of the lower left hand corner of the rectangle and the X and Y side lengths in kilometers. One corner and the side lengths are used because a true rectangle (four right angle corners) would not be developed if all four corners were not expressed relative to the same UTM zone. The UTM northing (Y) axis in one zone is not parallel to one in a neighboring zone.

The user is cautioned that when applying growth coefficients, a coefficient for both population and housing is required. The CAASE1 program expects two coefficients for each rectangle of growth. If only the housing count or only the population count is to be modified, the user must input a coefficient of 1.0 for the count that is not to be modified. If the coefficient of growth for a rectangle is left blank for either housing or population, the CAASE1 program will interpret the coefficient as being equal to zero and will eliminate the count for enumeration districts located within the rectangle. By using a growth coefficient of zero, CAASE1 does facilitate the removal of a housing area, for example, through urban renewal projects.

In the case of adding pseudo-enumeration districts to the MED-X census data, all parameters that are used by the CAASE2 program must be included; an output record similar to an original MED-X input record is written. All parameters needed by CAASE2 appear in the same positions in each record as though they were actual enumeration districts. The record written for each pseudo-enumeration district has blanks for those data fields of no interest to the CAASE method, for example, congressional district codes. For each pseudo-enumeration district, the required information includes: state and county FIPS codes, UTM zone number, X and Y (easting and northing) UTM coordinates of the center of area, housing count, and population count. Because of the order of processing in CAASE1, pseudo-enumeration districts do not have coefficients of growth applied to them even if they are located inside a growth rectangle.

The MED-X census data is used directly as input to CAASE1. The MED-X data organization is such that all data for each state appears as a separate file. Twenty-six (26) states and the District of Columbia are on one tape reel (volume) and twenty-four (24) states are on the second tape reel. Within each file, all records for one county are grouped together followed by the records for the next county and so forth. The order of counties within each state is alphabetical by county name. Because of program coding, the selected states must be requested by FIPS code in ascending order; the requested counties within each state also must be in FIPS code ascending order. (EPA and other users have obtained MED-X data tapes from DUALabs.*)

In designating a primary UTM zone for a study area that includes data from two neighboring UTM zones, care must be taken. In selecting the primary

---

*National Data Use and Access Laboratories, Arlington, Virginia.

UTM zone, the user would normally select the zone containing the highest percentage of included area of the total study area. There is some distortion introduced in converting location coordinates from one UTM zone to another. This can be minimized by selecting the primary zone causing the least amount of zone-to-zone conversion. These considerations notwithstanding, the user is cautioned that decisions made in using CAASE1 can yield undesirable results in other CAASE programs. For example, in CAASE5, the input cards for the dispersion models are produced. In the case of the Implementation Planning Program (IPP), the "X" location coordinates cannot exceed 999.9 km because of the field width; also, no provision is made for a signed value. The user, therefore, should designate a primary zone that will not cause "pseudo" negative UTM coordinates or easting (X) coordinates greater than 999.9 km in the conversion process.

The program uses the subroutine GTGR (grid-to-grid) for zone-to-zone conversion of coordinates. GTGR uses an 8 by 8 by 61 set of tables for the conversion algorithm. These tables are stored on a Fortran-defined direct access file. These tables and a simple Fortran program for creating a direct access disk file for input to the GTGR subroutine are included in Appendix F.

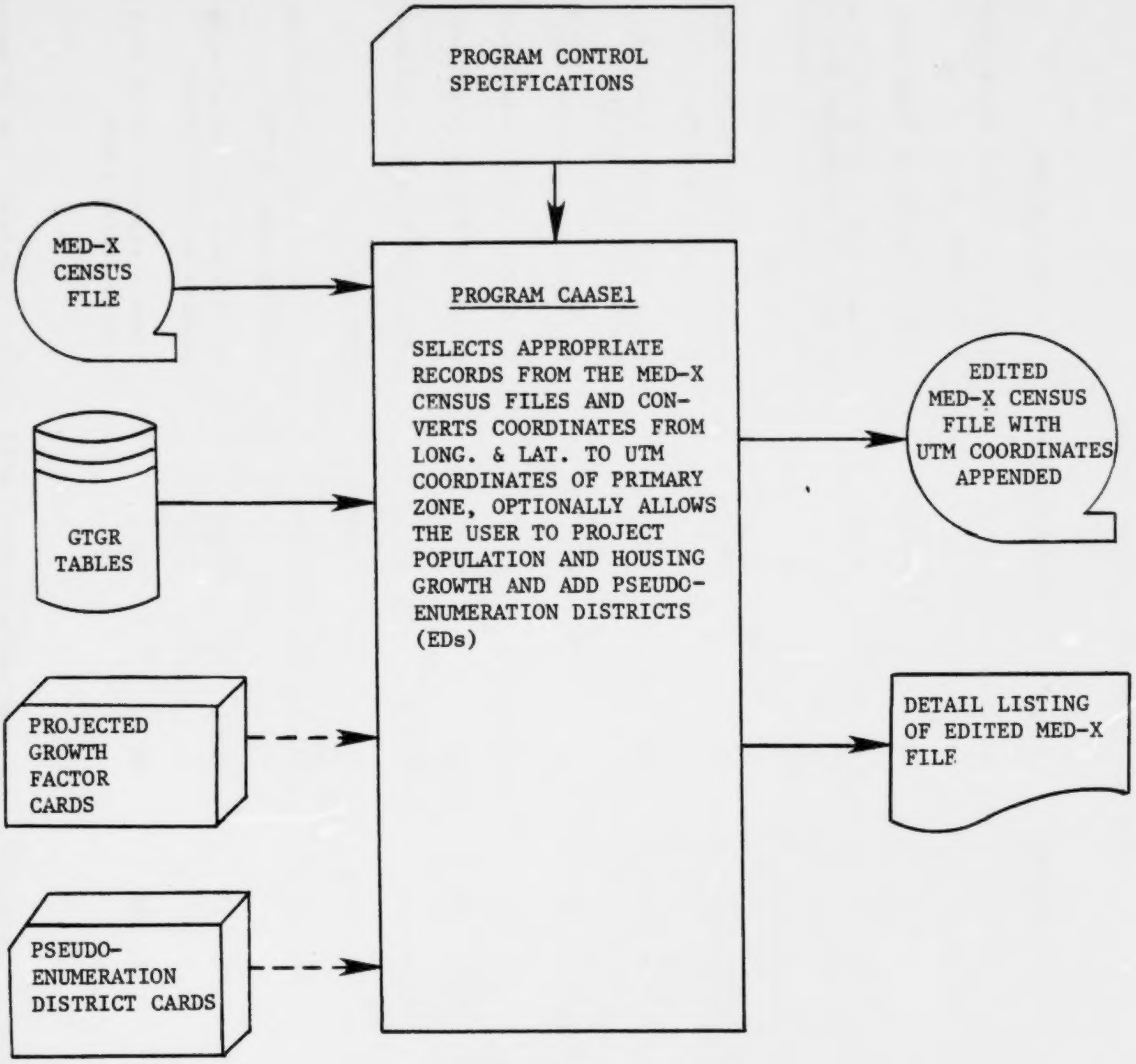
CAASE1 uses the CED009 subroutine for converting coordinates from geographic latitude and longitude to the UTM easting and northing system.

These subroutines are described in Section 7. Logical flowcharts and source language listings for CAASE1 and its subroutines are included in Appendix A.

Figure 2 is a system flowchart of the CAASE1 program.

2.2 Input Information

A description of the punched card variables input in the runstream appears in Table 1. The card input includes: the name of the study area, the number of


PROGRAM CONTROL SPECIFICATIONS
MED-X CENSUS FILE
PROGRAM CAASE1
SELECTS APPROPRIATE RECORDS FROM THE MED-X CENSUS FILES AND CONVERTS COORDINATES FROM LONG. & LAT. TO UTM COORDINATES OF PRIMARY ZONE, OPTIONALLY ALLOWS THE USER TO PROJECT POPULATION AND HOUSING GROWTH AND ADD PSEUDO-ENUMERATION DISTRICTS (EDs)
EDITED MED-X CENSUS FILE WITH UTM COORDINATES APPENDED
GTGR TABLES
PROJECTED GROWTH FACTOR CARDS
DETAIL LISTING OF EDITED MED-X FILE
PSEUDO-ENUMERATION DISTRICT CARDS

----- = Optional

FIGURE 2. SYSTEM FLOWCHART OF CAASE1 PROGRAM

TABLE 1. INPUT CARD LAYOUT, CAASE1

Card Type	Card Columns	Format	Variable Name	Description
STUDY AREA CARD	1 - 4	I4	NSTAT	Number of states in selected study area
	5 - 24	5A4	AQCR	Name of selected study area
	25 - 28	I4	KZONE	Primary UTM zone of selected study area (required even if entire study area is located in one zone)
GROWTH/PSEUDO ED OPTION CARD	1 - 5	I5	IGROTH	Projected growth factor option switch (non-zero for option)
	6 - 10	I5	IEDS	Pseudo ED's option switch (non-zero for option)
PROJECTED GROWTH CARDS (MAXIMUM = 100)	1 - 10	I5	X	X-coordinate (UTM easting)*
	11 - 20	F10.0	Y	Y-coordinate (UTM northing)*
	21 - 30	F10.0	XL	Length of X axis in kilometers
	31 - 40	F10.0	YL	Length of Y axis in kilometers
	41 - 45	I5	JZONE	UTM zone*
	46 - 55	F10.0	HCOEF	Coefficient for calculating housing count growth
	56 - 65	F10.0	PCOEF	Coefficient for calculating population count growth
GROWTH DELIMITER CARD	1 - 80	80X	--	Blank - signals end of projected growth factor cards

---

*Of lower left hand corner of rectangle, true zone number, CAASE1 will convert to primary zone if necessary.

TABLE 1. INPUT CARD LAYOUT, CAASE1 (CONTINUED)

Card Type	Card Columns	Format	Variable Name	Description
PSEUDO ED CARDS (MAXIMUM = 100)	1 - 10	F10.0	XX	X coordinate (UTM easting)
	11 - 20	F10.0	YY	Y coordinate (UTM northing)
	21 - 25	I5	KZONE	UTM zone*
	26 - 30	I5	ISTAT	FIPS state code
	31 - 35	I5	KOUNTY	FIPS county code
	36 - 45	F10.0	HCOUNT	Housing count (unscaled)
	46 - 55	F10.0	PCOUNT	Population count (unscaled)
PSEUDO ED DELIMITER CARD	1 - 80	80X	--	Blank - signals end of pseudo ED cards
STATE CARD	1 - 4	I4	NCNTY	Number of counties in selected state (maximum = 30)
	5 - 24	5A4	STATE	Name of selected state
	25 - 28	I4	KSTATE	FIPS state code number of selected state
COUNTY CARDS	1 - 4	I4	ICNTY	FIPS county code number of selected county
	5 - 24	5A4	CNTY	Name of selected county

---

*True zone number, CAASE1 will convert to primary zone if necessary.

states in the study area, the name of each state, the number of selected counties in each of the selected states, the Federal (FIPS) county and state code numbers, and the name of each county. Also included is the primary UTM zone number and program control variables indicating whether areas (rectangles) of growth and/or pseudo-enumeration districts are to be input.

Figure 3 shows the input order and the deck configuration for the various card types.

The MED-X census data tapes are read directly by CAASE1. The record layout for the MED-X tapes appears in Table 2. As discussed above, each state appears as a separate file and the total data set requires two reels of tape. Each state requires a set of Job Control Language (JCL) data definition (DD) cards. An example is included in Section 2.5

Conversion tables are used for converting UTM coordinates to the primary UTM zone when necessary. These tables must be written to a Fortran-defined direct access file before using the CAASE1 program. CAASE1 automatically reads the tables when a zone-to-zone conversion is necessary.

2.3 Output Information

Printed output from the program includes the names of the study area, state(s), and county(ies) being processed. Also printed are the input variables describing all rectangles of growth, pseudo-enumeration districts, and the total number of each (optionally input) for the entire study area. When all records for a county of interest have been processed, the county name, its number, and the number of records written on magnetic tape are printed. Figure 4 is an example of printed output from CAASE1. For each county, the first 25 records of the edited MED-X data are printed. These records are not shown in Figure 4. The number 25 was arbitrarily chosen when the CAASE1 source code was written; the user can easily change the number if desired.

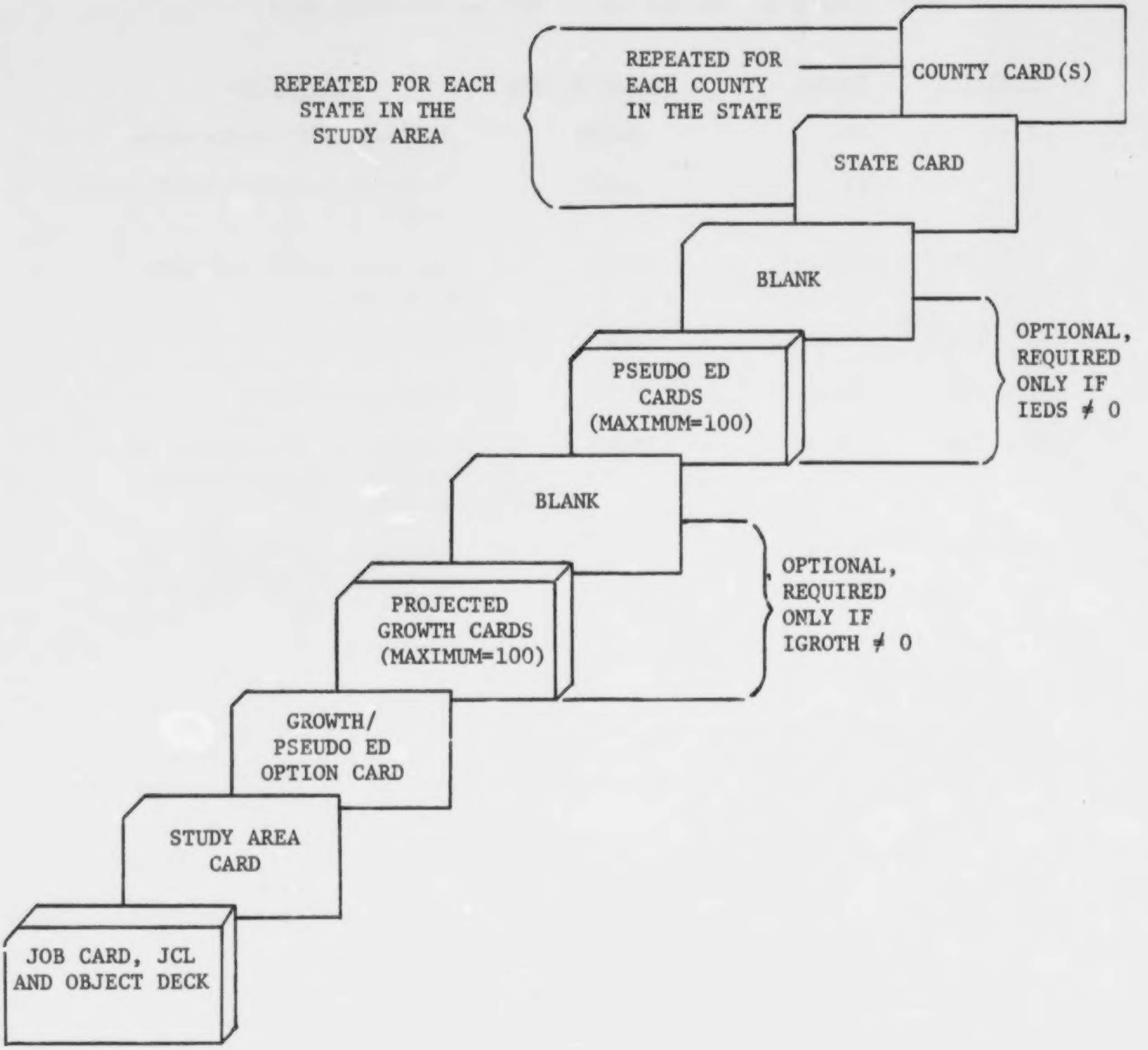

REPEATED FOR EACH STATE IN THE STUDY AREA
REPEATED FOR EACH COUNTY IN THE STATE
COUNTY CARD(S)
STATE CARD
BLANK
OPTIONAL, REQUIRED ONLY IF IEDS ≠ 0
PSEUDO ED CARDS (MAXIMUM=100)
BLANK
OPTIONAL, REQUIRED ONLY IF IGROTH ≠ 0
PROJECTED GROWTH CARDS (MAXIMUM=100)
GROWTH/ PSEUDO ED OPTION CARD
STUDY AREA CARD
JOB CARD, JCL AND OBJECT DECK

FIGURE 3. INPUT DECK CONFIGURATION FOR CAASE1 PROGRAM

TABLE 2. RECORD LAYOUT FOR MED-X CENSUS FILE

Position	Format	Variable Name	Definition
1 - 4	A4	XDATA	1970 and 1960 state codes
5 - 7	I3	JCNTY	Federal standard (FIPS) county code
8 - 93	21A4,A2	XDATA	Not applicable to CAASE programs
94 - 100	F7.0	XHOUS	Housing count
101 - 108	F8.0	XPOP	Population count
109 - 118	F10.4	XLONG	Longitude, in degrees, of centroid of enumeration district (ED)*
119 - 128	F10.4	XLAT	Latitude, in degrees, of centroid of enumeration district (ED)*

---

*If longitude and latitude are both zeroes, the record is a summary count for several enumeration districts (CAASE1 therefore skips the record).

```
CAASE1

STUDY AREA IS PARKERSBURG-MARIETTA
     NO. OF STATES INCLUDED IS 2        PRIMARY UTM ZONE IS 17


                 9ATHENS

               105MEIGS

               115MORGAN

               167WASHINGTON

     THE STATE OF OHIO              HAS     4 COUNTY(IES)


     THE STATE OF OHIO          CODE NO.       NO. OF RECORDS
       COUNTY NAME                             WRITTEN ON TAPE

          ATHENS                   9                 55

          MEIGS                  105                 28

          MORGAN                 115                 21

          WASHINGTON             167                 64


               35JACKSON

               73PLEASANTS

               95TYLER

              103WETZEL

              107WOOD

     THE STATE OF WEST VIRGINIA     HAS     5 COUNTY(IES)
```

FIGURE 4. EXAMPLE OF PRINTED OUTPUT FROM CAASE1

```
THE STATE OF WEST VIRGINIA         CODE NO.          NO OF RECORDS
     COUNTY NAME                                     WRITTEN ON TAPE

        JACKSON                       35                   24

        PLEASANTS                     73                   12

        TYLER                         95                   15

        WETZEL                       103                   28

        WOOD                         107                  131

GOOD FINISH
```

FIGURE 4. EXAMPLE OF PRINTED OUTPUT FROM CAASE1 (CONT.)

A magnetic tape is written where the first records for each county are the optional pseudo-enumeration districts. In addition to the data fields read from the MED-X tape, each record on the output tape (i.e., the edited MED-X data) includes the primary UTM zone number, UTM easting and northing coordinates, and a code number. The code number indicates whether the housing and population counts have been modified for the enumeration district or if it identifies a pseudo-enumeration district. A record layout for the edited MED-X tape appears in Table 3.

No growth areas or pseudo-enumeration districts were introduced to CAASE1 in the Parkersburg-Marietta AQCR study area used as an example in this manual.

Self-explanatory error messages are printed when appropriate, and, if the error is fatal, the program operation is terminated.

2.4 Job Control Language (JCL) and Deck Setup

An example of a deck setup configuration is illustrated in Figure 3. Using the Parkersburg-Marietta AQCR (#179) as an example study area, the associated JCL and input data cards are illustrated in Figure 5 and describe the following:

A. The program is in object deck form.

B. The edited MED-X census data file will be written on tape as Fortran unit number 4. It will be labeled "AQCR179.EDITED.MEDX.CENSUS". The volume and serial name is "AAAAAA".

C. The grid-to-grid conversion tables file is on disk as Fortran unit number 5. It is labeled "GRDTB66". The volume and serial name is "BBBBBB".

D. The MED-X census data for Ohio is on tape as Fortran unit number 6 and physical file number 21. It is labeled "OHIO". The volume and serial name is "CCCCCC".

TABLE 3. RECORD LAYOUT FOR EDITED MED-X FILE

Position	Format	Variable Name	Definition
1 - 4	A4	XDATA	1970 and 1960 state code
5 - 8	I4	JCNTY	Federal standard (FIPS) county code
9 - 94	21A4,A2	XDATA	Not applicable to CAASE programs
95 - 101	F7.0	XHOUS	Housing count
102 - 109	F8.0	XPOP	Population count
110 - 134	D25.16	XLONG	Longitude, in degrees of centroid of enumeration district (ED)
135 - 159	D25.16	XLAT	Latitude, in degrees of centroid of enumeration district (ED)
160 - 164	I5	KZONE	Primary UTM zone
165 - 179	F15.2	XOUT	UTM coordinate (easting) for this enumeration district
180 - 194	F15.2	YOUT	UTM coordinate (northing) for this enumeration district
195 - 198	I4	KODE	Describes type of record, where: 1 Denotes housing and population counts unchanged 2 Denotes modification of housing and/or population count in record by a growth coefficient 3 Denotes record is a pseudo-enumeration district*

---

*A pseudo-enumeration district is one optionally provided by the CAASE user to represent housing and population growth since the census year represented by the MED-X input data.

```
//CAASE1 JOB RTI.C44.P01303,'BURT, PKB-MAR',MSGLEVEL=1,PRTY=0,T=5
// EXEC FTGLGD
//L.SYSIN DD *
                        --PROGRAM OBJECT DECK(S)--
/*
//*  FT04 IS THE OUTPUT OF CAASE1 CONTAINING THE EDITED SUBSET OF
//*  THE CENSUS DATA FROM THE MED-X TAPE PLUS ANY USER-DEFINED
//*  CHANGES, ALL WITH UTM COORDINATES APPENDED.  USED BY
//*  CAASE2 AND (OPTIONALLY) CAASE3.
//G.FT04F001 DD DSNAME=AQCR179.EDITED.MEDX.CENSUS,UNIT=TAPE,
//              LABEL=(01,SL),DISP=(NEW,KEEP),
//              DCB=(RECFM=FB,BLKSIZE=2970,LRECL=198,DEN=2),RING=IN,
//              VOLUME=SER=AAAAAA
//*
//*  GRID-TO-GRID CONVERSION TABLES, BASED ON THE CLARKE
//*  1866 SPHEROID.  MUST BE ON DASD, AS CREATED BY
//*  PROGRAM AND TABLES INCLUDED IN APPENDIX F.
//G.FT05F001 DD DSNAME=GRDTB66,UNIT=DISK,
//              DCB=(RECFM=FB,BLKSIZE=512,LRECL=512),SPACE=(TRK,(5,1)),
//              DISP=(OLD,KEEP),VOLUME=SER=BBBBBB
//*
//*  FOLLOWING ARE THE DD CARDS FOR THE MED-X CENSUS
//*  DATA FILES FOR THE STATE(S) IN THE STUDY AREA.  NOTE
//*  THAT EACH FILE MUST HAVE A SEPARATE FORTRAN UNIT
//*  NUMBER BEGINNING WITH FT06F001 (CONCATENATION IS NOT ALLOWED),
//*  AND THAT THE NUMBERS MUST BE IN ASCENDING SEQUENCE TO MATCH
//*  THE CONTROL CARD SEQUENCE.
//G.FT06F001 DD DSNAME=OHIO,UNIT=TAPE,LABEL=(21,SL),DISP=(OLD,KEEP),
//              DCB=(RECFM=FB,BLKSIZE=1980,LRECL=132,DEN=2),
//              VOLUME=SER=CCCCCC
//G.FT07F001 DD DSNAME=WVA,UNIT=TAPE,LABEL=(24,SL),DISP=(OLD,KEEP),
//              DCB=(RECFM=FB,BLKSIZE=1980,LRECL=132,DEN=2),
//              VOLUME=SER=CCCCCC
//G.SYSIN DD *
   2PARKERSBURG-MARIETTA  17
    0    0
   4OHIO
 009ATHENS
 105MEIGS
 115MORGAN
 167WASHINGTON
   5WEST VIRGINIA
 035JACKSON
 073PLEASANTS
 095TYLER
 103WETZEL
 107WOOD
/*
//
```

FIGURE 5. JCL AND INPUT DATA CARDS FOR CAASE1

E. The MED-X census data for West Virginia is on tape as Fortran unit number 7 and physical file number 24. It is labeled "WVA". The volume and serial name is "CCCCCC". (Ohio and West Virginia are on the same tape reel. For one state, the Fortran unit number expected is 6; the unit number is increased by 1 for each additional state.)

F. The state and county select cards are on the installation dependent standard card input device. The study area includes data from two states and the primary UTM zone is 17. Four Ohio counties and five West Virginia counties are to be selected. No growth area or pseudo-enumeration district cards are to be read.

G. The printer is the installation dependent standard device number.

[At the installation where CAASE was developed, the catalogued procedure "FTGLGD" that will be executed (Fortran G, Link-Edit and Go - object decks are to be input) assigns Fortran I/O device numbers 1, 2, and 3 to the card reader, card punch, and printer respectively.]

2.5 Warnings and Limitations

For study areas including data from two UTM zones, the importance of selecting the primary zone was discussed above. If the user simply makes an error on assigning the primary UTM zone number, e.g., a keypunch error (or omission), the results will be unpredictable and erroneous.

CAASE1 dimensions have been written to accept up to 100 rectangles of growth and up to 100 pseudo-enumeration districts; this should prove adequate, but the user can easily increase the dimensions if necessary.

3.0 CAASE2 PROGRAM

3.1 Program Description

CAASE2 computes a system of grid squares over a user-defined collection of counties (the study area) on the basis of the population contained within the study area. The objective is to produce a grid system such that each grid square contains approximately the same number of people. This means, in application, that regions of high population density are partitioned into a large number of small squares and regions of low population density are partitioned into a small number of large squares. The population contained in any grid square is given by the integral of that portion of the entire population density surface that is contained in the square. The partition is such that the population is approximately the same from square to square.

In developing a grid system by hand, census tract maps showing the populations and outlines of the various census tracts in the study area are used with transparent overlays on which the grid squares are drawn. (This procedure is described in the EPA publication "Guide for Compiling a Comprehensive Emission Inventory," APTD 1135, pp. 7-5 through 7-10.) The population within a given census tract is assumed to be uniformly distributed. The population in the fractional area of a census tract that falls within a grid square is assigned to that grid square; therefore, the final total population of a grid square is the sum of all such fractional contributions from one or more census tracts.

Unfortunately, data for the census tract boundaries do not exist in machine readable (computerized) form. To have an automated gridding system, it is necessary to approximate in some manner the outlines of the census tracts. CAASE2 employs the method of proximal map construction to estimate the previously unknown census tract boundaries. After the approximate boundaries are established, the previous assumption of uniform population distribution is made and grid squares are constructed on the resulting population density distribution (surface).

Several steps in CAASE2 leading to the construction of the grid square system, deal with (1) the definition of the study area in terms of numerical county outline data, (2) the creation of a proximal map and a population density surface, and (3) the gridding procedure. Ignoring the details of step (1), and, assuming a defined study area of 1 km by 1 km unit cells, the construction of the proximal map and the population density surface takes place as follows. Each unit cell has an assigned value of 1 km^2 if it is interior to the boundary, 0 km^2 if it is exterior to the boundary, and a value betweeen 0 and 1 km^2 if it is on, or transected by, the boundary. Essentially, this is the operative definition of the study area. Also, associated with each cell are the census enumeration districts (ED's) whose centroid coordinates fall within that cell. There may be none, one, or more such ED's for a cell. Unit cells with one or more ED's assigned to them are called control cells analagous to the cartographer's phraseology of control points (data) in topographic map construction. The proximal map is constructed by assigning to each non-control cell the value of the control cell nearest it. A random number decides ties. Thus, for each control cell there is a collection of non-control cells, namely those closer to it than to other control cells. Collectively, these cells approximate the original census tract (at least down to the resolution afforded by 1 km by 1 km grid cells). The cell areas are summed to obtain the total ED area. The ED population divided by this area is the population density, i.e., the population per square kilometer, throughout the collection of cells. Since all the cell sizes are 1 km^2, the value of population density assigned to each cell is simply the population in that cell. While the discussion has been limited to population, the same applies to housing and housing density.

The above process is applied to every control cell. Eventually, the entire study area has values of population (and housing) assigned to all unit cells. This set of values is the population density surface.

The gridding procedure attempts to overlay grid squares on the proximal map so that each square contains approximately the same population. (The population of any grid square is simply the sum of the populations of the unit cells in that square.) Somewhere there is at least one unit cell of maximum population, and this unit cell will be the smallest grid square. This maximum value of population is approximately the population which all other squares are to contain in the partitioning. Thus, the grid system with the study area centered within it is initially a set of squares of equal size that are probably "too large." "Too large" a square means that the total population in the square exceeds the maximum population previously mentioned. The square is then partitioned into 4 smaller squares (daughters) by dividing its side length by 2. The daughters are added to the list of squares in the system. The daughters are then tested for being "too large." Any time the "too large" condition occurs, the square is partitioned down to the next smallest size, until the partitioning reaches the unit cell size, if necessary. If the "too large" condition does not occur, inspection passes to the next square in the list. If there are no more squares in the list, the procedure is completed.

The program uses four types of input data: (1) the edited census data file for each county created by CAASE1, (2) a tape file of county boundary coordinates, (3) punched cards specifying the control variables for the counties processed, and (4) the direct access file used also in CAASE1 for converting county boundary coordinates from one UTM zone to another when necessary. Outputs include a subset file of the particular county boundary coordinates, various diagnostic and error messages as appropriate, and the grid square file consisting of one record (punched card or card image) of information for each grid square.

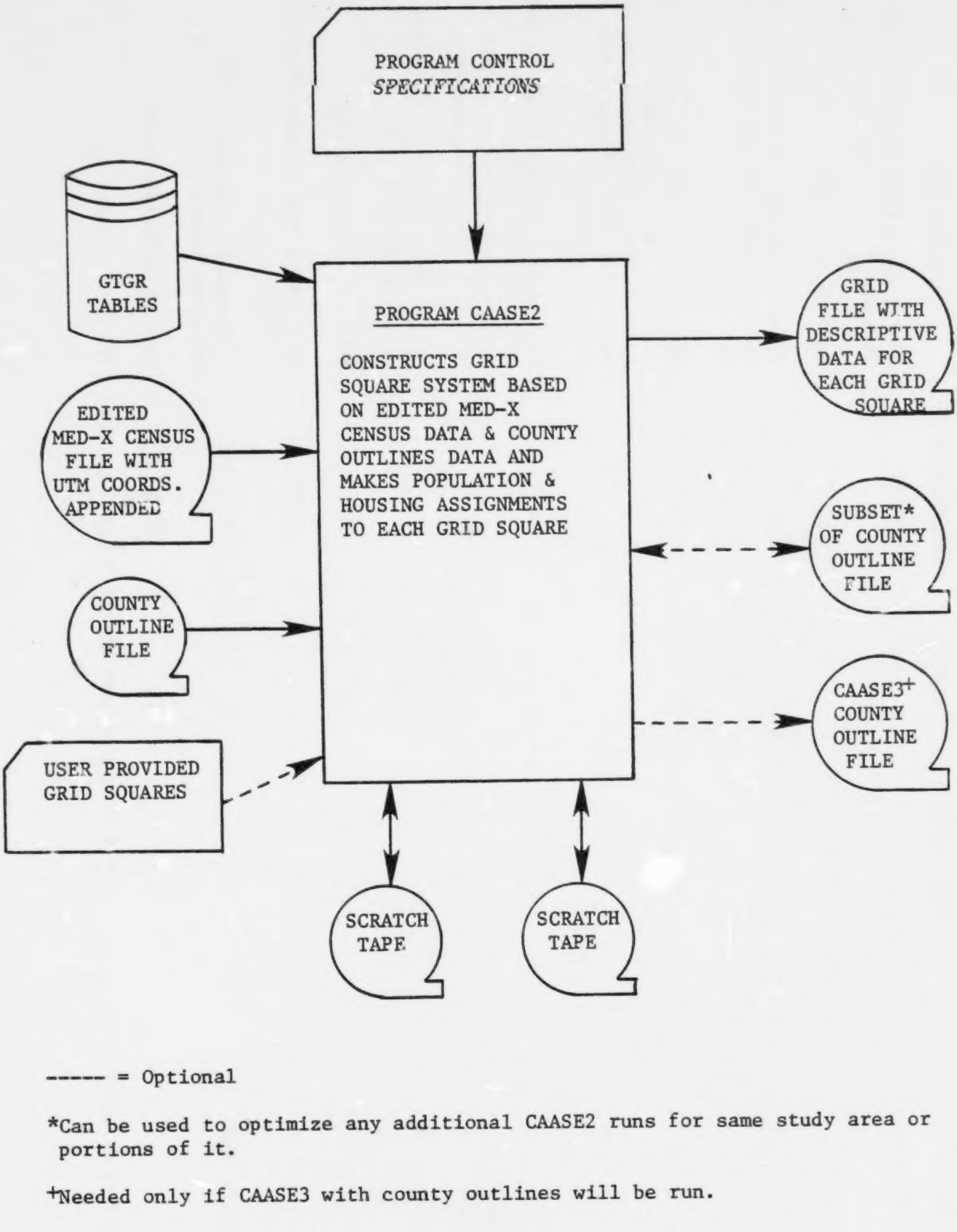
CAASE2 uses several subroutines that are described in Section 7. Logical flowcharts and source language listings for CAASE2 and its subroutines are included in Appendix B.

Figure 6 is a system flowchart for the CAASE2 program.

3.2 Input Information

A description and layout of the punched card input variables in the runstream appears in Table 4. Included are the name of the study area, the number of states in the study area, the name of each state, the number of counties in each state, the FIPS county and state code numbers, the name of each county, and the primary UTM zone. The input deck configuration is shown in Figure 7. The county outline input file is described in Table 5. The output tape of edited census data from CAASE1 is directly used as input to CAASE2. The same direct access file used by the GTGR subroutine in CAASE1 to convert enumeration district coordinates from one UTM zone to another is required in CAASE2 for GTGR conversion of county outline coordinates when necessary.

Punched card input to CAASE2 is identical to the Study Area, State, and County card types for CAASE1 (see Table 4) except for the variables NOUT3 and NPLOT on the Study Area card. A non-zero value for NOUT3 signifies that the user wishes to have the coordinates of the outlines of the counties in the study area written to output device NOUT3. This is appropriate when the user anticipates repeated processing of these outlines and needs to avoid possibly long, time-consuming tape I/O of the total county outline file. A non-zero value for NPLOT signifies that the user wants a county outline file written for input to CAASE3. (NOUT3 and NPLOT are formatted differently.)


PROGRAM CONTROL SPECIFICATIONS
GTGR TABLES
PROGRAM CAASE2
CONSTRUCTS GRID SQUARE SYSTEM BASED ON EDITED MED-X CENSUS DATA & COUNTY OUTLINES DATA AND MAKES POPULATION & HOUSING ASSIGNMENTS TO EACH GRID SQUARE
EDITED MED-X CENSUS FILE WITH UTM COORDS. APPENDED
COUNTY OUTLINE FILE
USER PROVIDED GRID SQUARES
GRID FILE WITH DESCRIPTIVE DATA FOR EACH GRID SQUARE
SUBSET* OF COUNTY OUTLINE FILE
CAASE3+ COUNTY OUTLINE FILE
SCRATCH TAPE
SCRATCH TAPE

----- = Optional

*Can be used to optimize any additional CAASE2 runs for same study area or portions of it.

+Needed only if CAASE3 with county outlines will be run.

FIGURE 6. SYSTEM FLOWCHART OF CAASE2 PROGRAM

TABLE 4. INPUT CARD LAYOUT, CAASE2

Card Type	Card Columns	Format	Variable Name	Definition
STUDY AREA CARD	1 - 4	I4	NSTAT	Number of states in study area (maximum = 10)
	5 - 24	5A4	AQCR	Name of study area
	25 - 28	I4	MTUZ	Primary UTM zone (required even if entire study area is located in one zone)
	29 - 32	I4	NOUT3	Tape device number to write county outlines subset for future CAASE2 runs of same study area. If zero, no writing will occur; hence, no tape is necessary.
	33 - 36	I4	NPLOT	Tape device number to write county outlines for CAASE3 input. If zero, no writing will occur; hence, no tape is necessary.
STATE CARD	1 - 4	I4	NCNTY	Number of counties in selected state (maximum = 15)
	5 - 24	5A4	STATE	Name of selected state
	25 - 28	I4	ICODE	FIPS state code number of selected county
COUNTY CARD	1 - 4	I4	IDCO	FIPS county code number of selected county
	5 - 24	5A4	CNTY	Name of selected county
USER GRID CARDS	[SEE THE GRID SQUARE RECORD FORMAT (COLUMNS 1-45 ONLY), TABLE 6]			

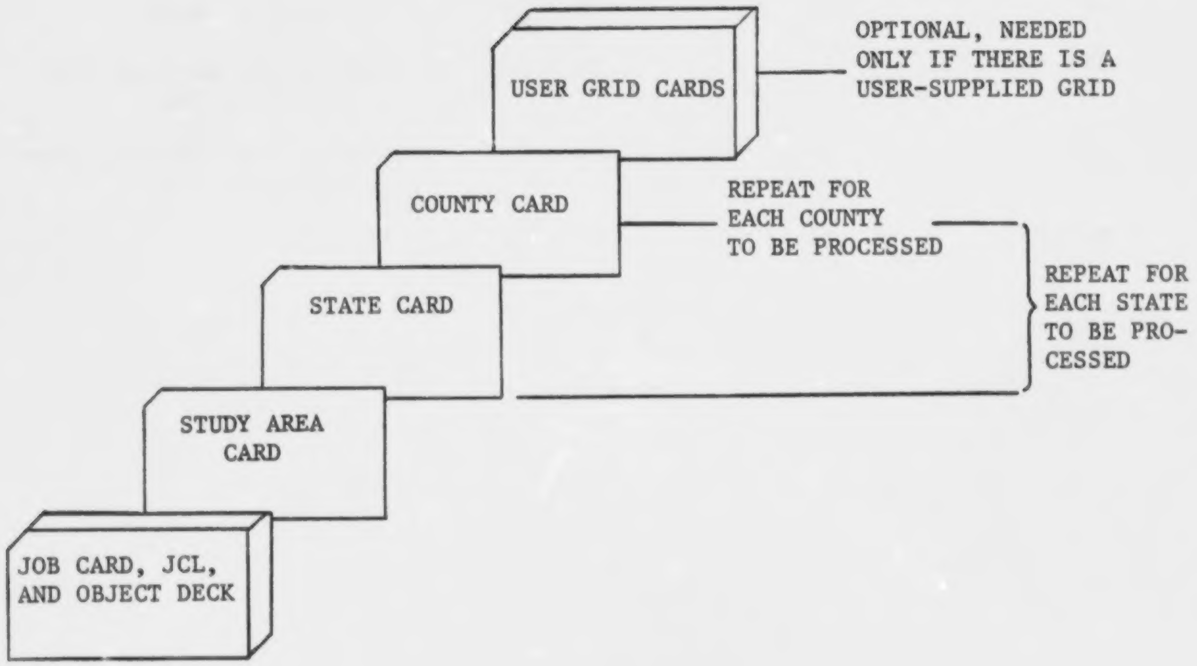

USER GRID CARDS
OPTIONAL, NEEDED ONLY IF THERE IS A USER-SUPPLIED GRID
COUNTY CARD
REPEAT FOR EACH COUNTY TO BE PROCESSED
STATE CARD
REPEAT FOR EACH STATE TO BE PROCESSED
STUDY AREA CARD
JOB CARD, JCL, AND OBJECT DECK

FIGURE 7. INPUT DECK CONFIGURATION FOR CAASE2 PROGRAM

TABLE 5. CAASE2 COUNTY OUTLINE FILE RECORD LAYOUT (FORTRAN UNITS "NIN1," "NOUT3"*)

Variable	Format	Columns	Comments
ID	I5	1 - 5	State-county code (FIPS)
--	12X	6 - 17	Not used by CAASE
IFE	I5	18 - 22	Starting node easting (UTM coordinates, km)
IFN	I5	23 - 27	Starting node northing (UTM coordinates, km)
--	2X	28 - 29	Not used by CAASE
ITE	I5	30 - 34	Ending node easting (UTM coordinates, km)
ITN	I5	35 - 39	Ending node northing (UTM coordinates, km)
MZONE	I2	40 - 41	UTM zone

---

*"NOUT3" contains a copy of "NIN1" for the study area counties only. "NOUT3" is created only if the variable NOUT3 is greater than zero on the "Study Area" input card (see Table 4).

If a user-provided grid is to be read in, the cards should be placed in the card input stream immediately following the last of the county cards described in Table 4 of this section. The content and format of the user-provided grid cards are identical* to the format of the punched card (or card image) output records produced by CAASE2 and described in Table 6 of this section.

3.3 Output Information

Printed output from CAASE2 includes the names of the study area (the AQCR name, for example), state(s) and county(ies); counts and/or totals of population, housing, Census Enumeration Districts (ED's), and county outline segments; computed county areas; a printer plotted map of each county showing the boundary and interior region; identification of any ED's whose coordinates place them outside their county of assignment; and a listing of the grid square records that are produced as punched card output or as card image records on other storage devices. Figure 8 is an example of parts of a printed output from CAASE2.

The format of the card image output for the grid square file is given in Table 6. A description of the contained variables appears in Table 7.

Two magnetic work tape output files are required. Two other files are optional. The two required files are necessary as temporary data storage to reduce computer core storage requirements. The first optional file (NOUT3) contains a subset of county outline coordinates that is pertinent to the study area. It is in the same format (see Table 5) as the input file. This option is provided for the user who anticipates running CAASE2 more than once. The second optional file (NPLOT) is created for use by CAASE3, if plotting the

---

*CAASE2 will assign housing and population counts; the user must provide the remaining data for each grid square.

```
AIR QUALITY CONTROL REGION IS PARKERSBURG-MARIETTA

    NO. OF STATE(S) INCLUDED IS    2          PRIMARY UTM ZONE IS   17

    THE STATE OF OHIO                  HAS   4 COUNTIES IN THE STUDY AREA   39

COUNTY ATHENS                 HAS STATE-CNTY CODE(FIPS)   39009

COUNTY MEIGS                  HAS STATE-CNTY CODE(FIPS)   39105

COUNTY MORGAN                 HAS STATE-CNTY CODE(FIPS)   39115

COUNTY WASHINGTON             HAS STATE-CNTY CODE(FIPS)   39167

    THE STATE OF WEST VIRGINIA         HAS   5 COUNTIES IN THE STUDY AREA   54

COUNTY JACKSON                HAS STATE-CNTY CODE(FIPS)   54035

COUNTY PLEASANTS              HAS STATE-CNTY CODE(FIPS)   54073

COUNTY TYLER                  HAS STATE-CNTY CODE(FIPS)   54095

COUNTY WETZEL                 HAS STATE-CNTY CODE(FIPS)   54103

COUNTY WOOD                   HAS STATE-CNTY CODE(FIPS)   54107
   39009        388.5   4338.0      437.4    4380.3
                399.6   4370.8      390.7    4371.6
                390.7   4371.6      389.6    4361.4
                389.6   4361.4      388.5    4351.3
                388.5   4351.3      391.4    4350.6
                391.4   4350.6      390.3    4341.0
                390.3   4341.0      435.3    4338.0
                435.3   4338.0      436.8    4341.8
                436.8   4341.8      437.4    4348.8
                437.4   4348.8      430.5    4349.5
                430.5   4349.5      430.0    4352.7
                430.0   4352.7      428.5
                428.5   4352.7         (ETC.)
```

FIGURE 8. EXAMPLE OF PRINTED OUTPUT FROM CAASE2

```
     STATECODE / COUNTY CODE / COUNTY NAME
  4        39       167  WASHINGTON

TRACKER COMPUTES TOTAL AREA OF WASHINGTON          COUNTY AS :  0.1680E 04
          111111111122222222223333333333444444444455555555556666666666777777777788888888889999999999
 123456789*123456789*123456789*123456789*123456789*123456789*123456789*123456789*123456789*123456789*
```

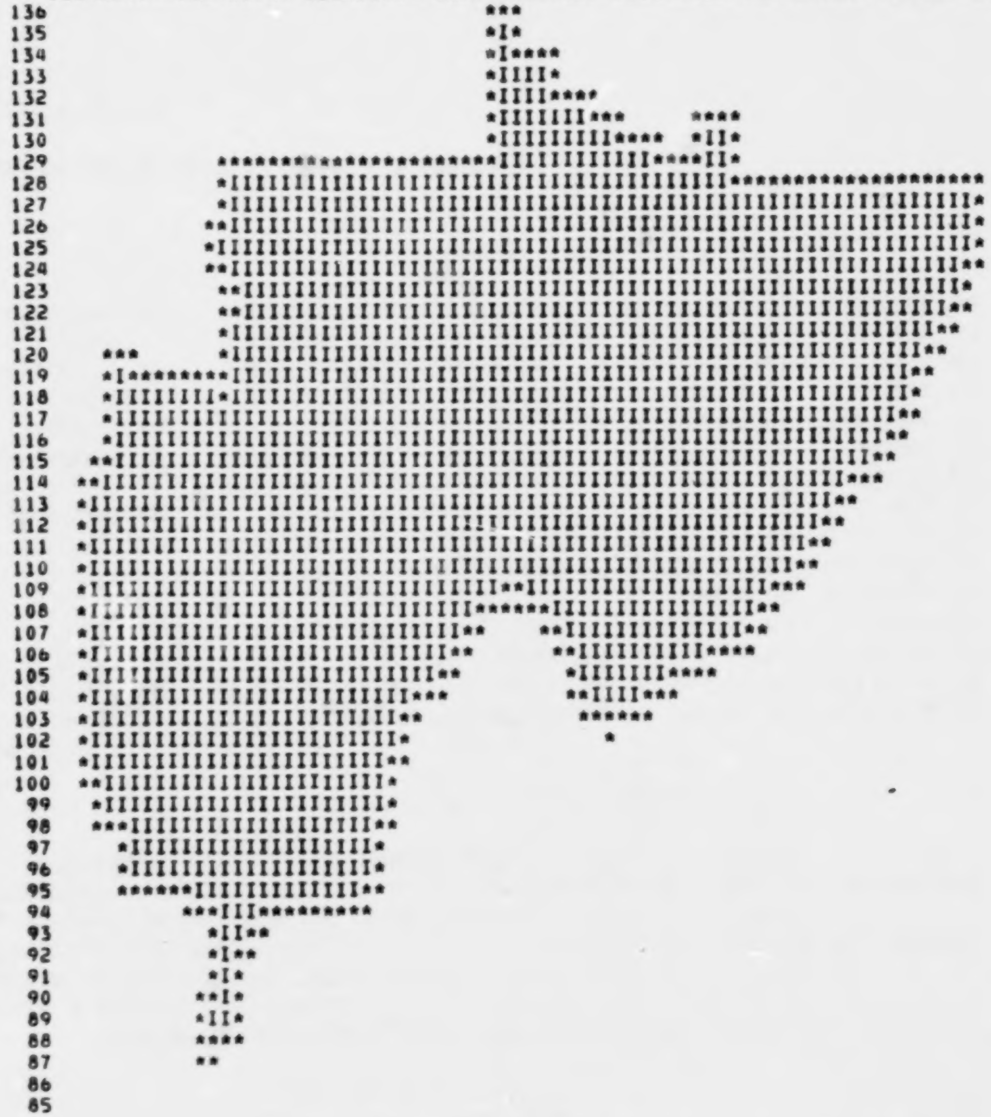

136
135
134
133
132
131
130
129
128
127
126
125
124
123
122
121
120
119
118
117
116
115
114
113
112
111
110
109
108
107
106
105
104
103
102
101
100
99
98
97
96
95
94
93
92
91
90
89
88
87
86
85

FIGURE 8. EXAMPLE OF PRINTED OUTPUT FROM CAASE2 (CONTINUED)

```
     STATECODE / COUNTY CODE / COUNTY NAME
  4          39       167  WASHINGTON

        AQCR POPULATION DATA,PARKERSBURG—MARIETTA
TOTAL  # RECORDS        READ:        169
 NUMBER OF RECORDS FOR THIS COUNTY:         64
SUBROUTINE PROXIMAL,  CELL #    1, I,J COORDINATES   93  79, IS OUTSIDE THE BOUNDARY OF THIS COUNTY.
ITS POPULATION AND HOUSING COUNTS ARE:      1225.       447.
SUBROUTINE PROXIMAL.  CELL #    5, I,J COORDINATES   94  79, IS OUTSIDE THE BOUNDARY OF THIS COUNTY.
ITS POPULATION AND HOUSING COUNTS ARE:       990.       357.
```

(Example of grid square printout.)

```
 373.4255. 565.4415.    17
    1 58132 39    9 17 389.000004335.00000 16  0.15976E 04  0.42842E 04
    2 71958 39    9 17 405.000004335.00000 16  0.10835E 04  0.29485E 04
    3 72368 39    9 17 421.000004335.00000 16  0.94466E 03  0.29529E 04
    4  1469 39    9 17 437.000004343.00000  8  0.11773E 02  0.37331E 02
    5  7095 39    9 17 385.000004351.00000  4  0.17940E 02  0.49096E 02
    6 99076 39    9 17 389.000004351.00000  8  0.65411E 03  0.18590E 04
    7100000 39    9 17 397.000004351.00000  4  0.75746E 03  0.20306E 04
    8100000 39    9 17 401.000004351.00000  2  0.20334E 03  0.51805E 03
    9100000 39    9 17 403.000004351.00000  1  0.10471E 02  0.24824E 02
   10100000 39    9 17 404.000004351.00000  1  0.18818E 02  0.53500E 02
   11100000 39    9 17 405.000004351.00000  4  0.12478E 04  0.49495E 04
   12100000 39    9 17 409.000004351.00000  4  0.98451E 02  0.24861E 03
   13100000 39    9 17 413.000004351.00000  8  0.24993E 03  0.67291E 03
   14 42463 39    9 17 421.000004351.00000 16  0.31156E 03  0.86567E 03
   15100000 39    9 17 403.000004352.00000  1  0.49400E 03  0.50680E 04
```

(ETC.)

```
 SUBROUTINE GRIDDIT,   FMAX = 0.50680E 04

  FINISH CAASE2
```

FIGURE 8. EXAMPLE OF PRINTED OUTPUT FROM CAASE2 (CONT.)

TABLE 6. FORMAT OF CARD IMAGE RECORDS OUTPUT FROM CAASE2

Record Type	Columns	Format	Variable Name
SUMMARY RECORD	1 - 5	F5.0	XORIG
	6 - 10	F5.0	YORIG
	11 - 15	F5.0	XEND
	16 - 20	F5.0	YEND
	21 - 25	I5	MTUZ
GRID SQUARE RECORD	1 - 5	I5	MM
	6 - 11	I6	IFRAC
	12 - 14	I3	ISTATE
	15 - 19	I5	ICOUNT
	20 - 22	I3	MTUZ
	23 - 32	F10.5	XX
	33 - 42	F10.5	YY
	43 - 45	I3	SL
	46 - 58	E13.5	HOUSIN
	59 - 71	E13.5	POPULA

NOTES:

The Summary Record occurs once as the first card in the file and serves as input to plotting routines in CAASE3.

The Grid Square Record occurs once for each of the grid squares that has been constructed.

See definitions of variables in Table 7.

TABLE 7. DEFINITIONS FOR VARIABLES OUTPUT FROM CAASE2 AS CARD IMAGES

Variable Name	Definition
XORIG	UTM Easting coordinate of the origin of the study area
YORIG	UTM Northing coordinate of the origin of the study area
XEND	The UTM Easting coordinate of the terminus of the study area
YEND	The UTM Northing coordinate of the terminus of the study area
MTUZ	The primary UTM zone of the study area as specified in CAASE1 by the user
MM	MM = 1,2,..., number of grid squares; the grid square number
IFRAC	Fractional area x10^6 of the grid square that is in county ICOUNT
ISTATE	FIPS number of state containing this grid square
ICOUNT	FIPS number of the county in state ISTATE containing this grid square
MTUZ	The primary UTM zone assigned to the study area
XX	UTM Easting coordinate of the southwest corner of the grid square
YY	UTM Northing coordinate of the southwest corner of the grid square
SL	Side length in kilometers of the grid square
HOUSIN	The housing from county ICOUNT that has been assigned to this grid square
POPULA	The population from county ICOUNT that has been assigned to this grid square

county boundaries by CAASE3 is desired. The layout and format of the optional subset county outline output file (NPLOT) for CAASE3 is given in Table 8.

3.4 Job Control Language (JCL) and Deck Setup

An example of a deck setup configuration is illustrated in Figure 7. Using the Parkersburg-Marietta AQCR (#179) as an example study area, the associated JCL and input data cards are illustrated in Figure 9 and describe the following:

A. The program is in object deck form.

B. The edited MED-X census data file (output from CAASE1) is on tape as Fortran unit number 7. It is labeled "AQCR179.EDITED.MEDX.CENSUS". The volume and serial name is "AAAAAA".

C. The grid-to-grid conversion tables file is on disk as Fortran unit number 5. It is labeled "GRDTB66". The volume and serial name is "BBBBBB".

D. The county outline data file is on tape as Fortran unit number 6. It is unlabeled. The volume and serial name is "EEEEEE".

E. A scratch (or work) tape is on Fortran unit number 8. It is labeled "&&POPULA". The volume and serial name is "FFFFFF".

F. A second scratch (or work) tape is on Fortran unit number 9. It is labeled "&&AREA". The volume and serial name is "GGGGGG".

G. The grid squares file will be written on tape as Fortran unit number 2. It will be labeled "AQCR179.GRID". The volume and serial name is "DDDDDD".

H. A subset of the county outline file for the study area (for any further CAASE2 runs) will be written on tape as Fortran unit number 12. It will be labeled "COUNTY.OUTLINES". The volume and serial name is "HHHHHH".

TABLE 8. RECORD LAYOUT FOR CAASE2 OPTIONAL COUNTY OUTLINES OUTPUT FILE* (FOR INPUT TO CAASE3)

RECORD TYPE 1: COUNTY HEADER RECORD

Variable	Format	Columns	Comments
IDPREV	I10	1 - 10	County ID (in this card type _only_) identifies this as header record
XL, YL	F10.1, F10.1	11 - 20, 21 - 30	"Lower left-hand corner" of county (easting, northing)
XH, YH	F10.1, F10.1	31 - 40, 41 - 50	"Upper right-hand corner" of county (easting, northing)

RECORD TYPE 2: BOUNDARY LINE SEGMENT RECORD

Variable	Format	Columns	Comments
	10X	1 - 10	
SMX(1,I)+, SMX(2,I)	F10.1, F10.1	11 - 20, 21 - 30	Start of line segment (easting, northing)
SMX(3,I), SMX(4,I)	F10.1, F10.1	31 - 40, 41 - 50	End of line segment (easting, northing)

---

[*] Output when the input variable "NPLOT" is greater than zero. Used by CAASE3 to plot county outlines on study area plot.

[+] I=ISTART, IEND for number of line segments for the county outline.

```
//CAASE2 JOB RTI.C44.P01303,JWD,M=1,PRTY=0,T=2
//*
//*  SAMPLE CAASE2 JCL.
//*
//*  TO LINKEDIT AND EXECUTE CAASE2 OBJECT DECKS
//*  FOR IBM 370/165
//*
//S1 EXEC FTHLGD,R.G.=460K
//L.SYSIN DD *
//*
//*    * * * * PROGRAM OBJECT DECKS GO HERE * * * *
//*
//*
//*  NP IS THE OUTPUT DEVICE FOR THE GRID SQUARES FILE, WHICH IS INPUT
//*      TO CAASE3 AND CAASE4.
//*  NP = 2 IN THE MAIN CALLING PROGRAM.
//G.FT02F001 DD DSN=AQCR179.GRID,UNIT=TAPE,VOL=SER=DDDDDD,
// DISP=(NEW,KEEP),LABEL=(1,SL),RING=IN,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=12960,BUFNO=1)
//*
//*  DEVICE FT05F001 CONTAINS THE UTM COORDINATE GRID-TO-GRID
//*  CONVERSION DATA TABLES, BASED ON THE CLARKE 1866 SPHEROID.
//*  THE DEVICE NUMBER, 5, HAS BEEN SET IN THE "BLOCK DATA" SUBROUTINE.
//FT05F001 DD DSN=GRDTB66,UNIT=DISK,
// DCB=(RECFM=FB,BLKSIZE=512,LRECL=512),
// DISP=OLD,VOL=SER=BBBBBB
//*
//*  NIN1  IS THE INPUT DEVICE CONTAINING THE COUNTY OUTLINE DATA FILE.
//*  NIN1 = 6 IN THE MAIN CALLING PROGRAM:
//FT06F001 DD DISP=OLD,UNIT=TAPE,VOL=SER=EEEEEE,LABEL=(1,NL),
// DCB=(RECFM=FB,LRECL=41,BLKSIZE=2050,BUFNO=1)
//*
//*  NIN2 IS THE INPUT DEVICE CONTAINING THE CAASE1 EDITED MED-X
//*  CENSUS DATA FILE.
//*  NIN2 = 7 IN THE MAIN CALLING PROGRAM:
//FT07F001 DD DISP=OLD,DCB=BUFNO=1,DSN=AQCR179.EDITED.MEDX.CENSUS,
// UNIT=TAPE,VOL=SER=AAAAAA,LABEL=(1,SL)
```

FIGURE 9. JCL AND INPUT DATA CARDS FOR CAASE2

```
//*
//*  NOUT1 IS A SCRATCH TAPE OUTPUT FILE.
//*  NOUT1 = 8 IN THE MAIN CALLING PROGRAM.
//FT08F001 DD DSN=&&POPULA,UNIT=TAPE,VOL=SER=FFFFFF,DISP=(,PASS),
// LABEL=(,NL),RING=IN,
// DCB=(RECFM=VBS,LRECL=1028,BLKSIZE=13000,BUFNO=1)
//*
//*  NOUT2 IS A SCRATCH TAPE OUTPUT FILE
//*  NOUT2 = 9 IN THE MAIN CALLING PROGRAM.
//FT09F001 DD DSN=&&AREA,UNIT=TAPE,VOL=SER=GGGGGG,DISP=(,PASS),
// LABEL=(,NL),RING=IN,
// DCB=(RECFM=VBS,LRECL=1028,BLKSIZE=13000,BUFNO=1)
//*
//*  NOUT3 IS THE OUTPUT DEVICE TO CONTAIN THE OPTIONAL SUBSET
//*  COUNTY OUTLINES FILE IN NIN1 FORMAT.
//*  NOUT3 = 12 ON THE FIRST CARD IN THE G.SYSIN INPUT STREAM.
//FT12F001 DD DSN=COUNTY.OUTLINES,UNIT=TAPE,VOL=SER=HHHHHH,
// LABEL=(,SL),DISP=(NEW,KEEP),RING=IN,
// DCB=(RECFM=FB,LRECL=41,BLKSIZE=12997,BUFNO=1)
//*
//*  NPLOT IS THE OPTIONAL SUBSET COUNTY OUTLINE FILE IN NOUT1 FORMAT.
//*  IT IS (OPTIONALLY) USED BY CAASE3.  NPLOT=15 ON THE FIRST
//*  CARD IN THE G.SYSIN INPUT STREAM.
//G.FT15F001 DD DSN=CNTY.PLOT,UNIT=TAPE,VOL=SER=IIIIII,
// LABEL=(,SL),DISP=(NEW,KEEP),RING=IN,
// DCB=(RECFM=FB,LRECL=50,BLKSIZE=2000,BUFNO=1)
//*
//*  SYSTEM INPUT DEVICE, SYSIN:
//G.SYSIN DD *
   2PARKERSBURG-MARIETTA  17  12  15
   4OHIO                  39
   9ATHENS
 105MEIGS
 115MORGAN
 167WASHINGTON
   5WEST VIRGINIA         54
  35JACKSON
  73PLEASANTS
  95TYLER
 103WETZEL
 107WOOD
/*
```

FIGURE 9. JCL AND INPUT DATA CARDS FOR CAASE2 (CONT.)

I. A subset of the county outline file for the study area (for CAASE3 plotting) will be written on tape as Fortran unit number 15. It will be labeled "CNTY.PLOT". The volume and serial name is "IIIIII".

J. The state and county selector cards are on the installation dependent standard card input device. The study area includes data for two states, and the primary UTM zone is 17. Four Ohio counties and five West Virginia counties are to be selected. Two subsets of the county outline file are requested, one for further CAASE2 processing (unit = 12) and the other for CAASE3 plotting (unit = 15).

K. The printer is the installation dependent standard device number.

[At the installation where CAASE was developed, the catalogued procedure "FTHLGD" that will be executed (Fortran H, Link-Edit and Go - object decks are to be input) assigns Fortran I/O device numbers 1, 2, and 3 to the card reader, card punch, and printer, respectively. The assignment of a tape to Fortran I/O unit number 2 (labeled "AQCR.GRID" on volume "DDDDDD") overrides the procedure's assignment of the card punch to Fortran I/O unit number 2. Card images will, therefore, be written on tape volume "DDDDDD".]

3.5 Warnings and Limitations

Many of the considerations involved in executing CAASE2 are the same as those previously described for CAASE1. CAASE2 relies on careful consideration of the inputs to CAASE1 for a properly edited census data file. There are additional considerations for CAASE2 which pertain mainly to FORTRAN DIMENSION limitations; those will be discussed later in this section. The modified DIME county outline file has not yet been completely subjected to application and may have data errors for some counties on the file that have not been accessed during the development and testing of CAASE2.

To simplify the card input and enhance compatibility with CAASE1, many variables are set in the main calling program instead of being read in. They are grouped together in the source listing for ease in identification and may be changed as circumstances warrant. A list of these variables appears in Table 9.

The extreme points (farthest north, farthest east, etc.) of the study area are determined by the county outlines. CAASE2 computes a rectangle that will contain the extreme points. The side lengths of the rectangle are the integer multiples of LTWO (see Table 9) that will just cover the study area centered in the rectangle. The southwest corner of the rectangle becomes the origin of the study area, and its coordinates are integers. The side lengths of the rectangle must not exceed DIMENY in the north-south direction or DIMENX in the east-west direction. It is advisable to actually measure the maximum extents of the study area before running CAASE2 to ensure that the array dimensions DIMENY and DIMENX are sufficiently large. The default value of 256 (km) should be sufficient for most applications. Smaller dimensions may be used and would result in more efficient computer utilization.

A major step in the program is to track the county outlines through the grid array of unit cells. This step, applied to each county, determines which cells within the total grid cell array are peculiar to that county, i.e., which cells are on the boundary, which cells are exterior, and which are interior to the county. Errors, if any, in the county outline data may produce unpredictable results; therefore, it is advisable to compare the computer printer version of the county map with an actual map. If errors exist, the user will have to make the necessary corrections to the county outline data.

The outline tracking procedure solves the equations for determining the intersection of two lines. In this procedure, the variable EPS (see Table 9)

TABLE 9. VARIABLES DEFINED IN CAASE2 MAIN CALLING PROGRAM

Variable	Default Value*	Definition
NR	1	The card reader device number
NP	3	The printer device number
NPUNCH	2	Device number for output of card images containing header and grid square variables (see Tables 6 and 7)
NIN1	6	Device number for county outline file
NIN2	7	Device number for the edited census data file from CAASE1
NOUT1	8	Device number for temporary data storage device 1; contains population and housing data maps
NOUT2	9	Device number for temporary data storage device 2; contains area data maps
LTWO	32	The maximum permissible grid square side length, where the units are irrelevant but kilometers are assumed; however, the length must be some power of 2, i.e., 2^n
DIMENY	256	A dimension value; it must be $\leq$ the minimum integer multiple of LTWO, i.e., $>$ the north-south extent of the study area.
DIMENX	256	Same as DIMENY but for the east-west extent of the study area
UNITAR	1.	Value of the basic unit area and the minimum size grid square, 1 Km
ISHIFT	2^{16}	A numeric shift multiplier for packing 2 numeric values in a single word where one value occupies bit positions 16 on up to word size
EPS	.0001	If $\lvert a-b\rvert <$EPS, $a=b$
MAXSQR	1800	The maximum permissible number of grid squares
MAXTRY	3	Inability to partition the study area into 1800 or fewer grid squares results in redefining the partitioning criteria and making another attempt - 3 times

---

*The user may wish to change the values to suit his own circumstances by changing the appropriate statements in the FORTRAN source code.

is used as zero when testing for equality. Erroneous results were obtained using too small a value, .00001, on the 32-bit word IBM 370/165. The value .0001 corrected the problems.

Having established the unit cells belonging to a specific county, the program checks the census data to ensure that the ED census coordinates will fall within either a boundary cell or an interior cell. If the ED coordinates fall in an exterior cell,* a message is printed and the program continues. The population and housing of the ED are retained in the totals for the county, but the ED itself is no longer used (as a control cell) by the program.

The limitation of 1800 grid squares has placed a somewhat arbitrary limit on other variables which, for economy of computer core memory, share the same common storage as the grid square variables. These variables are the population and housing counts, the coordinates and area of the control cells, that is, those cells in the total grid cell array that contain population. There are five vectors used to store these variables. They are dimensioned 2520 each so that their total storage of 12,600 words equals the storage for the 7 grid square variables. One cannot predict in advance the number of control cells there will be in a particular study area; it is necessary to run CAASE2 to determine this. As previously mentioned, CAASE2 will restart if the number of grid squares being created exceeds 1800. However, if the 2520 storage limit on control cells is exceeded, a message is printed and the program stops. It would then be necessary to increase the dimensions of those variables which are in the COMMON block named VECFO.

---

*This condition occasionally occurs because of data errors or the differences in the degree of resolution in the MED-X coordinates as compared to the county outline line segments.

Grid squares that are transected by the outermost boundary of the study area may have an excessive amount of their area exterior to the study area. Such squares are partitioned if the interior area is less than 50 percent of the square's area. There is a minimum side length below which grid squares are not tested for contained area; this value has been set in ENTRY ADJUST, in subroutine GRIDIT, as 4*UNITAR.

If the user supplies a set of grid squares and any square(s) contain area for more than one county, only one description of the square should be input. For those grid squares containing area from more than one county, it is immaterial which county's square is used. In the CAASE2 processing, the selection of a grid square network for the entire study area will be bypassed. However, in later processing by CAASE2, the "shared area" test is made in subroutine SQROFF and a grid square is produced for each county sharing the grid square's area. Therefore, if the grid square network was produced by an earlier CAASE2 run, the user must remove grid squares that have duplicate location coordinates but different county assignments. Failure to do so will result in having redundant grid squares output.

4.0 CAASE3 PROGRAM

4.1 Program Description

The CAASE3 program is optional, but its use is recommended if plotting facilities are available. When used, it provides the user with an off-line plotter display of area source grid squares as defined by CAASE2. In addition, the user may optionally specify that CAASE3 plots county boundaries and/or enumeration districts for the study area. All input data except control card information is produced by either CAASE1 or CAASE2. Control card information specifies the desired scale, whether the user desires enumeration districts and/or county outlines to appear on the plot, and the name (label) the user wishes to appear on the plot.

CAASE3 reads the control cards from the input stream., The minimum and maximum study area information is read from the grid square file output from CAASE2. Scaling is computed, and an error message followed by a run abort occurs if the 29" (assumed) paper width would be exceeded. The output of grid squares from CAASE2 is read, and a run abort occurs if the maximum number of grid squares is exceeded.

Subroutines are called by CAASE3 to actually drive the plotter. POPBOX, EDPLOT, and COOUT subroutines plot the grid, enumeration districts and county outlines, respectively. They are described in Sections 7.27 through 7.29.

The standard plotting scale is 1:250,000; this usually requires wide (29") plotting paper for a significant study area. The user must arrange for appropriate plotter paper either through JCL or direct contact with the operator.

Logical flowcharts and source language listings for CAASE3 and its subroutines are included in Appendix C.

Figure 10 is a system flowchart of the CAASE3 program.

Preceding page blank

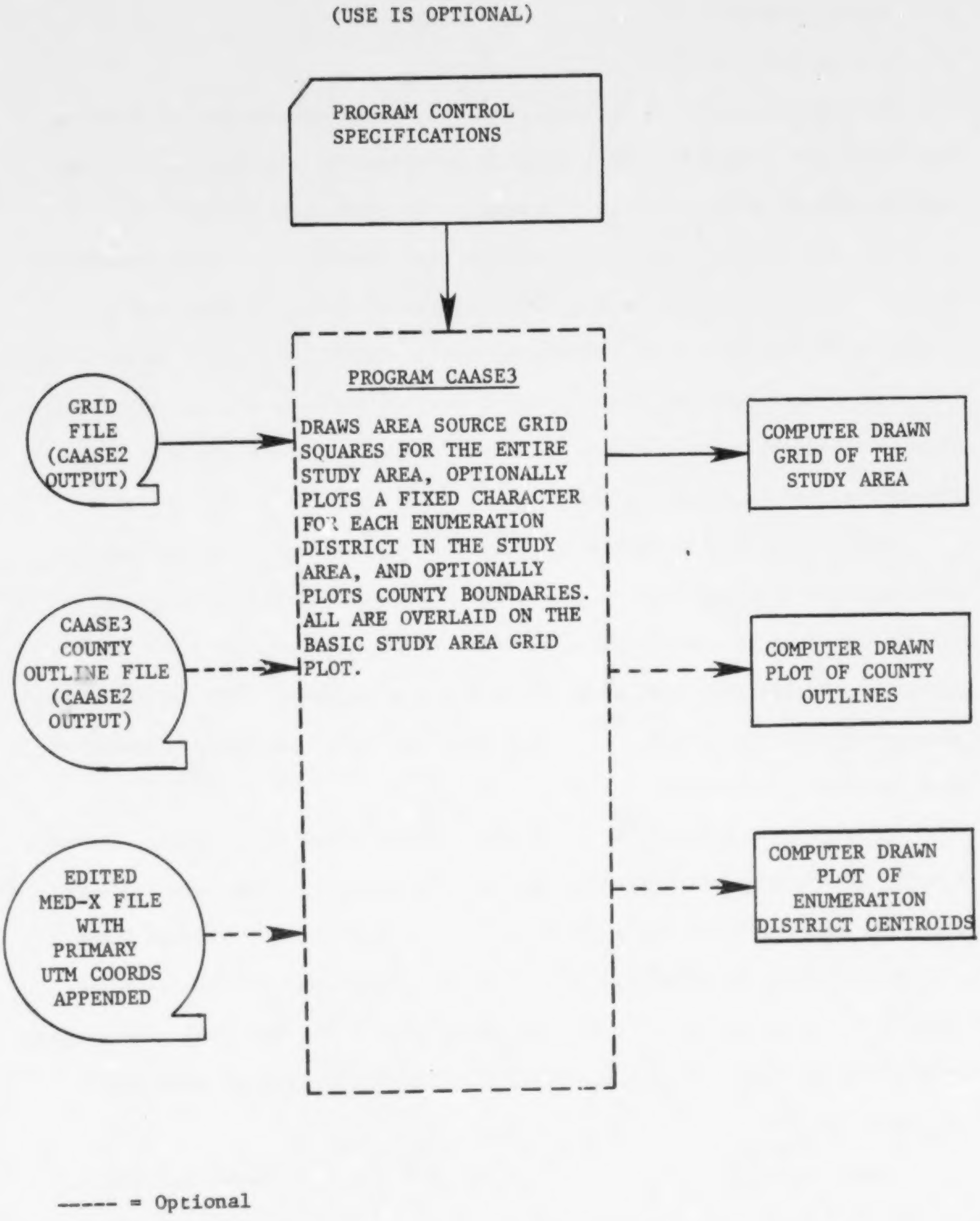

(USE IS OPTIONAL)
PROGRAM CONTROL SPECIFICATIONS
PROGRAM CAASE3
DRAWS AREA SOURCE GRID SQUARES FOR THE ENTIRE STUDY AREA, OPTIONALLY PLOTS A FIXED CHARACTER FOR EACH ENUMERATION DISTRICT IN THE STUDY AREA, AND OPTIONALLY PLOTS COUNTY BOUNDARIES. ALL ARE OVERLAID ON THE BASIC STUDY AREA GRID PLOT.
GRID FILE (CAASE2 OUTPUT)
CAASE3 COUNTY OUTLINE FILE (CAASE2 OUTPUT)
EDITED MED-X FILE WITH PRIMARY UTM COORDS APPENDED
COMPUTER DRAWN GRID OF THE STUDY AREA
COMPUTER DRAWN PLOT OF COUNTY OUTLINES
COMPUTER DRAWN PLOT OF ENUMERATION DISTRICT CENTROIDS
---- = Optional

FIGURE 10. SYSTEM FLOWCHART OF CAASE3 PROGRAM

4.2 Input Information

A description of the punched card variables input in the runstream appears in Table 10. The card input includes: a scaling factor multiplier, plot request parameters for the enumeration district and county outline plotting options, and a title of up to 20 characters for labeling the plot.

Figure 11 shows the input order and deck configuration.

The grid square file output from CAASE2 is used as direct input to CAASE3. The record layouts and descriptions for this file are contained in Tables 6 and 7.

If the plotting of enumeration districts is requested, the edited MED-X file output from CAASE1 is used as direct input to CAASE3. The record layout and description of the file are shown in Table 3.

If county outlines are to be plotted, the subset of the county outline file output from CAASE2 is used as direct input to CAASE3. The record layout and description of the file are shown in Table 11.

4.3 Output Information

The CAASE3 computer-driven line plotter output contains as minimum output a frame with tick marks representing every 5-km on each axis, labels, a title, a scale legend, and the entire study area grid. County outlines and/or enumeration districts are included only at the user's request. All are plotted to the scale selected by the user. Figure 12 is an example of plotter output for the Parkersburg-Marietta AQCR (#179) example study area; the plotter output includes the grid array, enumeration districts, and county outlines.

A printer listing of all grid squares as read from the input file is provided. This listing also includes a display of the study area name for identification purposes, statements of user request of enumeration district

TABLE 10. INPUT CARD LAYOUT, CAASE3

Card Type	Card Columns	Format	Variable Name	Description
PROGRAM CONTROL CARD	1 - 12	F12.0	SCALEX	Scale factor multiplier to convert kilometer distances to plotter inches
	13 - 24	I12	IXER	Enumeration district plot request parameter
	25 - 36	I12	ICO	County outline plot request parameter
STUDY AREA CARD	1 - 20	5A4	AQCR	Name of study area

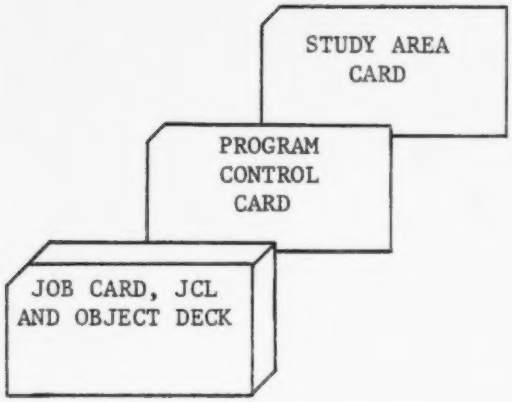

STUDY AREA CARD
PROGRAM CONTROL CARD
JOB CARD, JCL AND OBJECT DECK

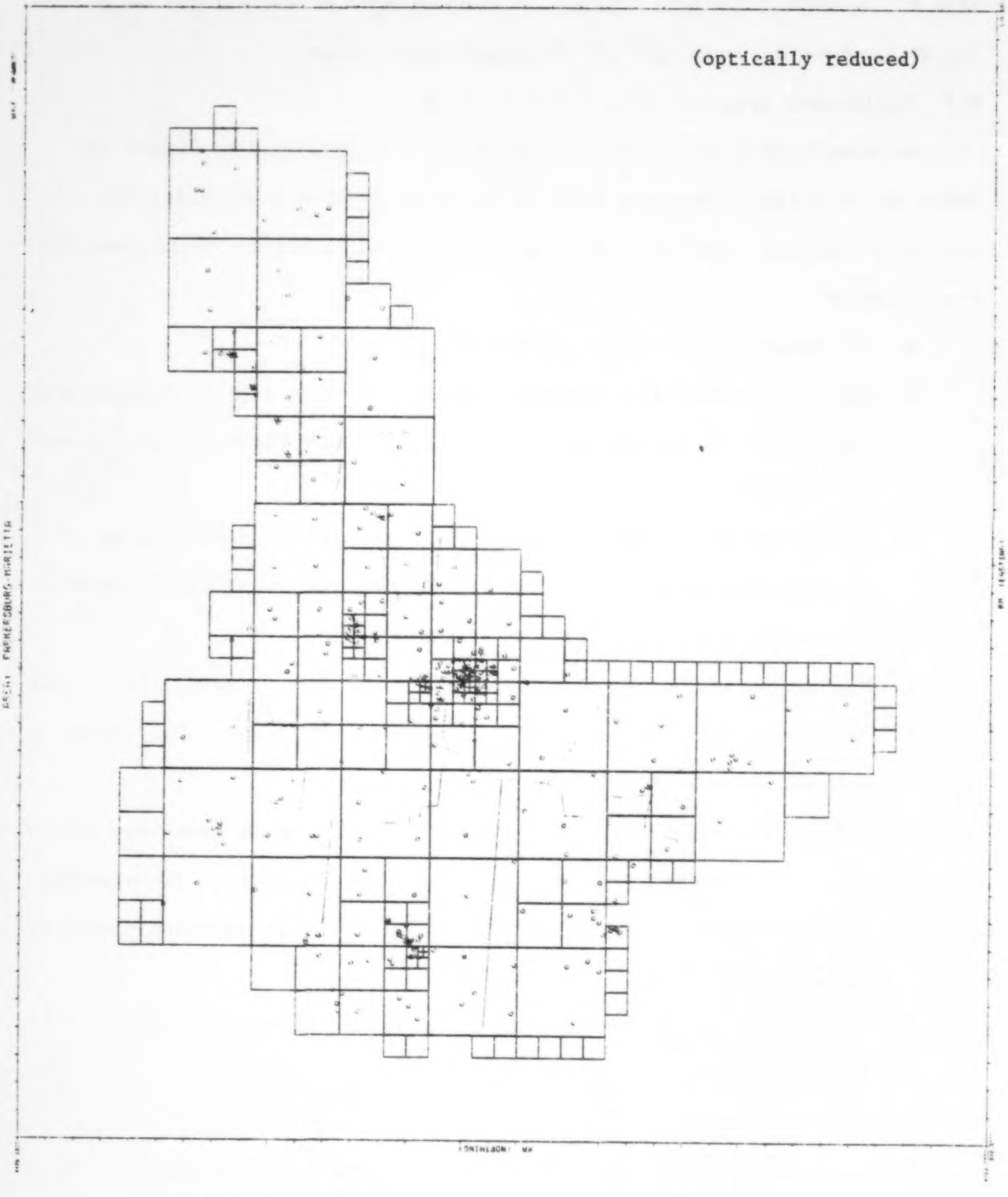
FIGURE 11. INPUT DECK CONFIGURATION FOR CAASE3 PROGRAM

TABLE 11. CAASE3 COUNTY OUTLINE FILE[*] RECORD LAYOUT (FORTRAN UNIT 12)

Variable	Format	Columns	Comments
IST, IMY	I7, I3	1 - 7, 8 - 10	State and county ID. Nonzero values identify this as header record (skipped)
FROM(1), FROM(2)	F10.1, F10.1	11 - 20, 21 - 30	Start of line segment (easting, northing)
TO(1), TO(2)	F10.1, F10.1	31 - 40, 41 - 50	End of line segment (easting, northing)

---

[*] Optional CAASE2 output.



AREA: PARKERSBURG-MARIETTA
KM NORTHING
KM EASTING

(optically reduced)

FIGURE 12. EXAMPLE OF PLOTTER OUTPUT FROM CAASE3

and/or county outline plotting, the minimum and maximum easting and northing (in the primary UTM zone) of the grid itself, and a statement of the actual size of the plot in inches. Figure 13 is an example of the printed output for the Parkersburg-Marietta AQCR (#179) example study area.

4.4 Job Control Language (JCL) and Deck Setup

An example of a deck setup configuration is illustrated in Figure 11. Using the Parkersburg-Marietta AQCR (#179) as an example study area, the associated JCL and input data cards are illustrated in Figure 14 and describe the following:

A. The program is in object deck form.

B. The grid squares file (output from CAASE2) is on tape as Fortran unit number 20. It is labeled "AQCR179.GRID". The volume and serial name is "DDDDDD".

C. The edited MED-X census data (output from CAASE1) is on tape as Fortran unit number 10. It is labeled "AQCR179.EDITED.MEDX.CENSUS". The volume and serial name is "AAAAAA".

D. The subset of the county outline file (output from CAASE2) is on tape as Fortran unit number 12. It is labeled "CNTY.PLOT". The volume and serial name is "IIIIII".

E. The scaling factor, plot option variables, and study area name are on the installation dependent standard card input device. The standard 1:250,000 scale has been selected. Plotting of enumeration districts and county outlines is requested.

F. The printer and plotter are the installation dependent standard device numbers.

4.5 Warnings and Limitations

The user should check the size of the study area on a USGS map to determine whether the requested map scale will fit on twenty-nine (29) inch

```
                        CAASE3

STUDY AREA IS PARKERSBURG-MARIETTA

ENUMERATION DISTRICTS TO BE PLOTTED

COUNTY OUTLINES TO BE PLOTTED

          EASTING   NORTHING

MINIMUM     373.      4255.

MAXIMUM     565.      4415.

PLOT WILL COVER 16.1 X 13.8 INCHES

          BOX    XPOINT     YPOINT     SIDE     STATE    COUNTY

            1     389.0     4335.0     16.0       39         9
            2     405.0     4335.0     16.0       39         9
            3     421.0     4335.0     16.0       39         9
            4     437.0     4343.0      8.0       39         9
            5     385.0     4351.0      4.0       39         9
            6     389.0     4351.0      8.0       39         9
            7     397.0     4351.0      4.0       39         9
            8     401.0     4351.0      2.0       39         9
            9     403.0     4351.0      1.0       39         9
           10     404.0     4351.0      1.0       39         9
           11     405.0     4351.0      4.0       39         9
           12     409.0     4351.0      4.0       39         9
           13     413.0     4351.0      8.0       39         9
           14     421.0     4351.0     16.0       39         9
           15     403.0     4352.0      1.0       39         9

                             (ETC.)

          273     449.0     4355.0      4.0       54       107
          274     453.0     4359.0      4.0       54       107
          275     457.0     4359.0      4.0       54       107
          276     461.0     4359.0      4.0       54       107
          277     465.0     4359.0      4.0       54       107
          278     459.0     4363.0      2.0       54       107
          279     461.0     4363.0      2.0       54       107
378 TOTAL ENUMERATION DISTRICTS PLOTTED
378 CENSUS ENUMERATION DISTRICTS
  0 SCALED ENUMERATION DISTRICTS
  0 USER ENUMERATION DISTRICTS
  9 COUNTIES' OUTLINES PLOTTED.
```

FIGURE 13. EXAMPLE OF PRINTED OUTPUT FROM CAASE3

```
//CAASE3 JOB RTI.C44.P01303,PADDOCK,T=2,PRTY=0,PLOTS=10000
// EXEC FTGLGD
//L.SYSIN DD *
                         --- PROGRAM OBJECT DECK(S) ---
/*
//*
//*  NAQ IS THE INPUT DEVICE FOR THE GRID PRODUCED BY CAASE2
//*  (REQUIRED).  NAQ=20 IN CAASE3.
//G.FT20F001 DD DSN=AQCR179.GRID,UNIT=TAPE,VOL=SER=DDDDDD,
//              DISP=(OLD,KEEP),LABEL=(1,SL)
//*
//*  IEDFIL IS THE INPUT DEVICE CONTAINING (OPTIONAL) CENSUS
//*  ENUMERATION DISTRICT DATA FOR PLOTTING.  IEDFIL=10 IN
//*  CAASE3.  OPTION IS SELECTED BY IXER>0 IN THE G.SYSIN
//*  INPUT STREAM.
//G.FT10F001 DD DSN=AQCR179.EDITED.MEDX.CENSUS,UNIT=TAPE,
//              VOL=SER=AAAAAA,DISP=(OLD,KEEP),LABEL=(1,SL)
//*
//*  ICOFIL IS THE INPUT DEVICE CONTAINING (OPTIONAL) COUNTY
//*  OUTLINE DATA FOR PLOTTING.  ICOFIL=12 IN CAASE3.  OPTION IS
//*  SELECTED BY ICO>0 IN THE G.SYSIN INPUT STREAM.
//G.FT12F001 DD DSN=CNTY.PLOT,UNIT=TAPE,LABEL=(1,SL),
                VOL=SER=IIIIII,DISP=(OLD,KEEP)
//*
//*  DDNAME UNCPLOT IS THE PLOTTER OUTPUT DEVICE.
//*  PLOTTER DDNAME IS INSTALLATION DEPENDENT.
//G.UNCPLOT DD SYSOUT=C
//*  CONTROL CARDS FOLLOW
//G.SYSIN DD *
       1.0         1         1
PARKERSBURG-MARIETTA
/*
//
```

FIGURE 14. JCL AND INPUT DATA CARDS FOR CAASE3

wide plotter paper. The scaling factor, SCALEX, is divided into the constant 250,000 in the program to compute the map scale. A SCALEX equal to 1.0 yields a map scale of 1:250,000; 2.0 yields 1:125,000; etc. The program computes the plotting space needed and aborts with an error message if the plot will not fit on 29" wide paper. For this case a new scale is selected, e.g., 1:500,000, and the job resubmitted.

5.0 CAASE4 PROGRAM

5.1 Program Description

This program calculates apportioning factors for each area source emissions category for each grid square in the study area. The primary, but not limiting, objective of apportioning area source emissions to a sub-county grid is to provide better spatial resolution of area source emissions data for dispersion modeling analyses. (CAASE5, described in Section 6, uses the calculated apportioning factors to develop fractional coefficients used to allocate a portion of a county's total fuels and emissions to each source category-grid square combination.)

Fuels and emissions are allocated with the same apportioning factors. For example, housing counts for each grid square are used to calculate the apportioning factor for both distillate oil marketed for use as residential fuel and the emissions produced by its combustion.

CAASE4 is structured such that a main program, with only a few lines of source code, is used to set the dimensions of the arrays for the variables used. (This is done to conserve computer core storage requirements.) The main program needs to be recompiled only if array sizes are to be increased. After defining the variable dimensions, the main program calls the subroutine CAASE4, which does all of the work; the CAASE4 subroutine does not call any additional subroutines.

The program uses the grid square file output from the CAASE2 gridding program as direct input. Each county in the study area being processed is completely processed, in turn, before proceeding to the next county.

CAASE4 uses census based data and grid square size to calculate apportioning factors. This is a totally objective technique that the user can optionally modify. Objective factors used include, for each grid square: the fractional area of the grid square that is located in the county being

Preceding page blank

processed (1.0 unless a county border transects the grid square), the size and location of the grid square, and housing and population counts assigned to it for that county. From these data, population density and its inverse are calculated and also used for apportioning.

CAASE4 will use overriding weighting factors at the user's option. Most of the area source emissions categories can be effectively apportioned by CAASE4 without user intervention. For a few categories, the user will probably have data not directly available to CAASE, for example, the locations of airports, waterways, and railroads; for these categories (and any others), the user can prepare and input overriding weighting factors.

A detailed discussion of the objective apportioning factors, user-supplied overriding weighting factors, their rationale, and how to apply them, are included in Section 8. The method of introducing overriding weighting factors is discussed in Section 5.2, Input Information.

It is important for the CAASE user to fully understand a basic concept in the calculation of apportioning factors. All of the apportioning factors output from CAASE4 are "weighted apportioning factors." Each one is the product of an objective apportioning factor - for example, grid square contained population - and a weighting factor. The weighting factor is 1.0 unless overridden by the user. The CAASE user does not replace the objective apportioning factors when he uses the overriding option; he modifies the 1.0 (default) weighting factor coefficients of the objective apportioning factors.

For convenience, the fields of fuels (throughput) data on the NEDS Area Source Input Form [EPA (DUR) 219, 3/72] have been sequentially numbered by source category. Major category classifications (for example, residential fuel) and associated minor category classifications (for example, distillate oil) have been assigned a sequential category number. Table 12 relates the assigned sequential number to its major and minor classifications.

In the CAASE4 program, objective apportioning factors have been assigned to all area source categories. The tons per acre coefficients reported for forest wildfires, managed burning, and agricultural field burning are used to calculate total county fuels (throughput) for those source categories. They are, therefore, not subject to apportioning; their numeric values are included in CAASE4 outputs for use by CAASE5. The number of days orchard heaters are fired for frost control is also output without change for use by CAASE5.

The selection of array dimensions in the main program is based on the maximum count of grid squares included in any of the counties currently being processed and on the maximum number of source categories to be overridden by user-supplied weighting factors in any of those counties.

Figure 15 is a system flowchart of the CAASE4 program. Logical flowcharts and source language listings for CAASE4 are included in Appendix D.

5.2 Input Information

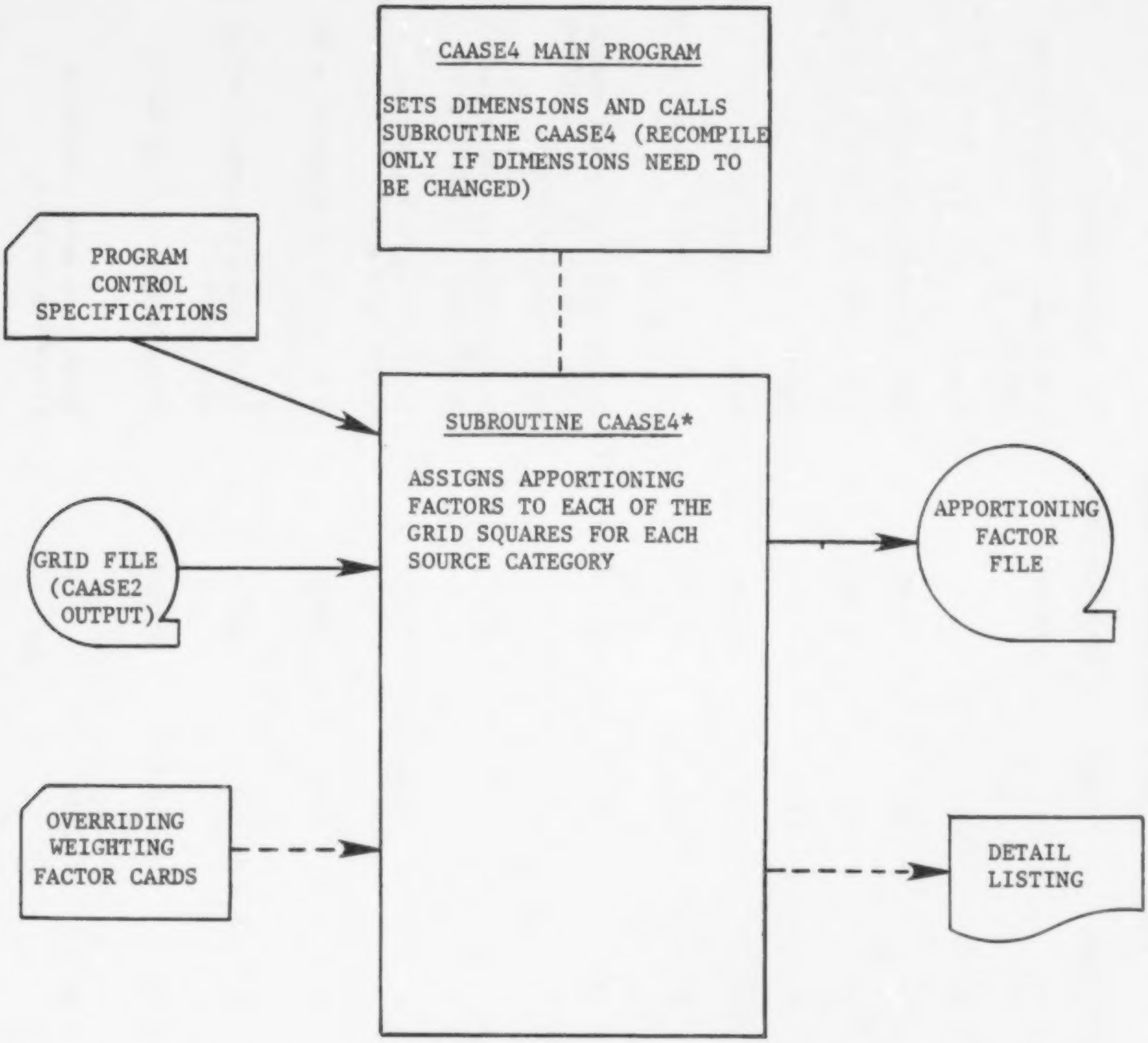
The input card variables, their layout, and descriptions are contained in Table 13. The county selector card contains the state and county FIPS code and name, the number of source categories to be overridden (if any), and a print switch option variable used to control the printing of computed apportioning factors. If source categories are to be overridden, then the source category number and its initialization constant are input for each of them. (This initializes those grid squares; overriding values need not be read in for every grid square if only one or a few are to receive apportioned fuels and emissions. For example, if all grid squares were initialized to zero for emissions from aircraft operations, the user would read in an overriding weighting factor for only those grid squares affected by aircraft

TABLE 12. AREA SOURCE EMISSIONS CATEGORY NUMBERS

CATEGORY NUMBER	MAJOR CLASSIFICATION	MINOR CLASSIFICATION
1	RESIDENTIAL FUEL	ANTH. COAL
2	RESIDENTIAL FUEL	BITUM. COAL
3	RESIDENTIAL FUEL	DIST. OIL
4	RESIDENTIAL FUEL	RESID. OIL
5	RESIDENTIAL FUEL	NAT. GAS
6	RESIDENTIAL FUEL	WOOD
7	COMM'L & INSTITL FUEL	ANTH. COAL
8	COMM'L & INSTITL FUEL	BITUM. COAL
9	COMM'L & INSTITL FUEL	DIST. OIL
10	COMM'L & INSTITL FUEL	RESID. OIL
11	COMM'L & INSTITL FUEL	NAT. GAS
12	COMM'L & INSTITL FUEL	WOOD
13	INDUSTRIAL FUEL	ANTH. COAL
14	INDUSTRIAL FUEL	BITUM. COAL
15	INDUSTRIAL FUEL	COKE
16	INDUSTRIAL FUEL	DIST. OIL
17	INDUSTRIAL FUEL	RESID. OIL
18	INDUSTRIAL FUEL	NAT. GAS
19	INDUSTRIAL FUEL	WOOD
20	INDUSTRIAL FUEL	PROCESS GAS
21	ON-SITE INCINERATION	RESIDENTIAL
22	ON-SITE INCINERATION	INDUSTRIAL
23	ON-SITE INCINERATION	COMM'L & INSTITL
24	OPEN BURNING	RESIDENTIAL
25	OPEN BURNING	INDUSTRIAL
26	OPEN BURNING	COMM'L & INSTITL
27	GASOLINE FUEL	LIGHT VEHICLE
28	GASOLINE FUEL	LIGHT TRUCK
29	GASOLINE FUEL	HEAVY VEHICLE
30	GASOLINE FUEL	OFF HIGHWAY
31	DIESEL FUEL	HEAVY VEHICLE
32	DIESEL FUEL	OFF HIGHWAY
33	DIESEL FUEL	RAIL LOCOMOTIVE
34	AIRCRAFT	MILITARY
35	AIRCRAFT	CIVIL
36	AIRCRAFT	COMMERCIAL
37	VESSELS	COAL
38	VESSELS	DIESEL OIL
39	VESSELS	RESID. OIL
40	VESSELS	GASOLINE
41	EVAPORATION	SOLVENT PURCHASED
42	EVAPORATION	GASOLINE MARKETED
43	MEASURED VEH MILES	LIMITED ACCESS RDS
44	MEASURED VEH MILES	RURAL ROADS
45	MEASURED VEH MILES	SUBURBAN RDS
46	MEASURED VEH MILES	URBAN ROADS
47	DIRT RDS TRAVELED	...
48	DIRT AIRSTRIPS	...
49	CONSTRUCTION ACRES	...
50	MISC. WIND EROSION	...
51	LAND TILLING	...
52	FOREST WILDFIRES*	AREA-ACRES
53	MANAGED BURNING*	AREA-ACRES
54	AGRI. FIELD BURNING*	AREA-ACRES
55	FROST CONTROL**	ORCHARD HEATERS
56	STRUCTURE FIRES	NO. PER YEAR

---

*Tons/acre also reported; **Days fired/year also reported.


CAASE4 MAIN PROGRAM
SETS DIMENSIONS AND CALLS SUBROUTINE CAASE4 (RECOMPILE ONLY IF DIMENSIONS NEED TO BE CHANGED)
PROGRAM CONTROL SPECIFICATIONS
SUBROUTINE CAASE4*
ASSIGNS APPORTIONING FACTORS TO EACH OF THE GRID SQUARES FOR EACH SOURCE CATEGORY
GRID FILE (CAASE2 OUTPUT)
APPORTIONING FACTOR FILE
OVERRIDING WEIGHTING FACTOR CARDS
DETAIL LISTING

*This is "effectively" the main program; the main (driver) CAASE4 Program is used only to set dimensions and call this subroutine.

----- = Optional

FIGURE 15. SYSTEM FLOWCHART OF CAASE4 PROGRAM

TABLE 13. INPUT CARD LAYOUT, CAASE4

Card Type	Card Columns	Format	Variable Name	Description
COUNTY SELECTOR CARD	1 - 5	I5	KOUNTY	FIPS county code of selected county
	6 - 10	5X	--	Blank
	11 - 30	5A4	CNAME	Name of selected county
	31 - 35	I5	KSTATE	FIPS state code of selected state
	36 - 40	5X	--	Blank
	41 - 60	5A4	SNAME	Name of selected state
	61 - 65	I5	IOVER	Number of source categories to be overridden
	66 - 70	I5	ITEST	Option switch to print computed apportioning factors (ITEST=0 suppresses printing)
SOURCE CATEGORY OVERRIDE OPTION CARD	1 - 5	I5	ICAT	Source category number for overriding weighting factor
	6 - 10	F5.0	XINIT	Initializing constant for weighting factor
OVERRIDE FACTOR CARD	1 - 10	I10	IDNUM	Area source grid square to be overridden
	11 - 20	I10	KAT	Source category number to be overridden
	21 - 30	F10.0	WEIGHT	Overriding weighting factor
OVERRIDE FACTOR DELIMITER CARD	1 - 80	80X	--	Blank - no more overriding weighting factors
RUN DELIMITER CARD	1 - 80	80X	--	Blank - no more counties to be processed

operations.) An override factor card for each grid square and source category combination to be overridden is necessary. Each card contains the grid square ID number, the source category number, and the desired overriding weighting factor.

The grid square file output from CAASE2 is used directly as input to CAASE4. These data include for each grid square in the county being processed: the ID number, the fractional area of the grid square contained in "this county," the state and county FIPS number, the UTM zone number, the UTM northing and easting coordinates of the southwest corner of the grid square, the "effective side length"* in kilometers of the grid square, and the housing and population assigned to the grid square in "this county." The record layouts and description for the grid square file output from CAASE2 are contained in Tables 6 and 7 (the summary record is output for CAASE3 but is not used by CAASE4).

Figure 16 shows the input order and deck configuration for the various card types.

5.3 Output Information

Error messages, diagnostic messages, information necessary to control the CAASE5 program, and a formatted magnetic tape with grid square descriptions and their weighted apportioning factors are output. Printed output varies according to the options selected. If overriding weighting factors and initializing coefficients for the overridden source categories are input, they will also be printed. If a detailed listing is requested (i.e., the variable ITEST is non-zero), identifying information and calculated apportioning

---

*If the fractional area of the grid square in "this county" is less than 1.0, the "effective side length" is the square root of the area contained in "this county."

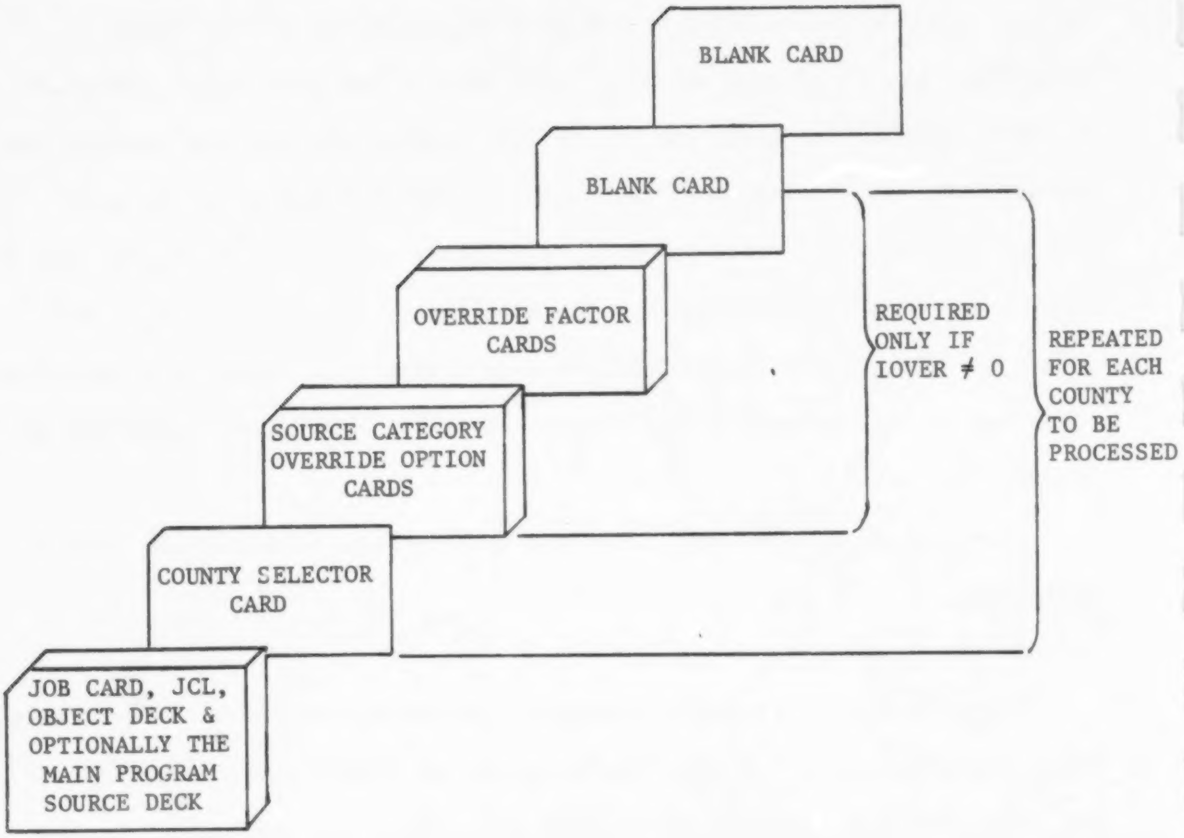

BLANK CARD
BLANK CARD
OVERRIDE FACTOR CARDS
SOURCE CATEGORY OVERRIDE OPTION CARDS
COUNTY SELECTOR CARD
JOB CARD, JCL, OBJECT DECK & OPTIONALLY THE MAIN PROGRAM SOURCE DECK
REQUIRED ONLY IF IOVER ≠ 0
REPEATED FOR EACH COUNTY TO BE PROCESSED

FIGURE 16. INPUT DECK CONFIGURATION FOR CAASE4 PROGRAM

factors for each grid square and source category combination will be printed. The state and county names and the number of grid squares* read in for the county are printed. Figure 17 is an example of CAASE4 printer output. (Note that no source categories were overridden.) Figure 18 is an example of a requested detailed listing for grid squares located in Washington County, Ohio. The detailed listing is printed in the same order as the grid squares are processed, which is generally by sequential ID numbers.

Figure 18 was prepared with printed output for two grid squares for purposes of the following discussion. Grid square number 97 is an 8 by 8 kilometer square containing 64 square kilometers of area; the variable FRAC (fraction) is 1.0 indicating that the entire grid square is located in Washington County; therefore, the "effective side length" is the same as the grid square side length. However, grid square number 98 is a 4 by 4 kilometer square containing 16 square kilometers of area; in this case, FRAC is 0.88633. Therefore, only 14.18 square kilometers of area are located within Washington County. The remaining area is located in one or more neighboring counties and could, in fact, be outside the study area of interest. In the case of grid square 98, the remaining 1.82 square kilometers are in Wood County, West Virginia, a neighboring county within the same AQCR. The "effective side length" for grid square number 98 is 3.7658. The calculated apportioning factors are printed (by row) in the same order as the source categories are reported (see Table 12). Again, referring to the values printed in Figure 18, note that the contained housing assigned to grid square number 97 is 488 (rounded to an integer); note that this number appears for the first five factors in the printout because the first five area source categories are

---

*The number of grid squares for each county is used to determine dimension requirements in the CAASE5 program.

```
STATE AND COUNTY  OHIO                   ATHENS              HAD          32 GRID SQUARES

        0  SOURCE CATEGORIES WERE OVERRIDDEN

STATE AND COUNTY  OHIO                   MEIGS               HAD          28 GRID SQUARES

        0  SOURCE CATEGORIES WERE OVERRIDDEN

STATE AND COUNTY  OHIO                   MORGAN              HAD          17 GRID SQUARES

        0  SOURCE CATEGORIES WERE OVERRIDDEN

STATE AND COUNTY  OHIO                   WASHINGTON          HAD          58 GRID SQUARES

        0  SOURCE CATEGORIES WERE OVERRIDDEN

STATE AND COUNTY  WEST VIRGINIA          JACKSON             HAD          26 GRID SQUARES

        0  SOURCE CATEGORIES WERE OVERRIDDEN

                                           (ETC.)

GOOD FINISH
```

FIGURE 17. EXAMPLE OF PRINTED OUTPUT FROM CAASE4

```
FOR ID,FRAC,STATE,COUNTY,ZONE,X,Y,SIDE,AND AREA=

  97   1.00000   39OHIO                    167 WASHINGTON          17      445.     4359.      8.00     64.00

FACTORS=

 0.48796E 03  0.48796E 03  0.48796E 03  0.48796E 03  0.48796E 03  0.48796E 03  0.16823E 04  0.16823E 04
 0.16823E 04  0.16823E 04  0.16823E 04  0.16823E 04  0.16823E 04  0.16823E 04  0.16823E 04  0.16823E 04
 0.16823E 04  0.16823E 04  0.16823E 04  0.16823E 04  0.48796E 03  0.16823E 04  0.16823E 04  0.48796E 03
 0.16823E 04  0.16823E 04  0.16823E 04  0.16823E 04  0.16823E 04  0.24348E 01  0.16823E 04  0.24348E 01
 0.80000E 01  0.64000E 02  0.64000E 02  0.64000E 02  0.80000E 01  0.80000E 01  0.80000E 01  0.80000E 01
 0.16823E 04  0.16823E 04  0.24348E 01  0.24348E 01  0.16823E 04  0.16823E 04  0.24348E 01  0.24348E 01
 0.64000E 02  0.24348E 01  0.24348E 01  0.24348E 01  0.24348E 01  0.24348E 01  0.24348E 01  0.16823E 04

CONTAINED POPULATION =      1682.   CONTAINED HOUSING =       488.   AREA WEIGHTED INVERSE POPULATION DENSITY =  0.24348E 01

SQUARE ROOT OF AREA (EFFECTIVE SIDE LENGTH) =    8.0000


FOR ID,FRAC,STATE,COUNTY,ZONE,X,Y,SIDE,AND AREA=

  98   0.88633   39OHIO                    167 WASHINGTON          17      453.     4359.      4.00     14.18

FACTORS=

 0.23781E 03  0.23781E 03  0.23781E 03  0.23781E 03  0.23781E 03  0.23781E 03  0.79521E 03  0.79521E 03
 0.79521E 03  0.79521E 03  0.79521E 03  0.79521E 03  0.79521E 03  0.79521E 03  0.79521E 03  0.79521E 03
 0.79521E 03  0.79521E 03  0.79521E 03  0.79521E 03  0.23781E 03  0.79521E 03  0.79521E 03  0.23781E 03
 0.79521E 03  0.79521E 03  0.79521E 03  0.79521E 03  0.79521E 03  0.25290E 00  0.79521E 03  0.25290E 00
 0.37658E 01  0.14181E 02  0.14181E 02  0.14181E 02  0.37658E 01  0.37658E 01  0.37658E 01  0.37658E 01
 0.79521E 03  0.79521E 03  0.25290E 00  0.25290E 00  0.79521E 03  0.79521E 03  0.25290E 00  0.25290E 00
 0.14181E 02  0.25290E 00  0.25290E 00  0.25290E 00  0.25290E 00  0.25290E 00  0.25290E 00  0.79521E 03

CONTAINED POPULATION =      795.   CONTAINED HOUSING =       238.   AREA WEIGHTED INVERSE POPULATION DENSITY =  0.25290E 00

SQUARE ROOT OF AREA (EFFECTIVE SIDE LENGTH) =    3.7658
```

FIGURE 18. EXAMPLE OF OPTIONAL DETAILED PRINTOUT OF APPORTIONING FACTORS, ETC., FROM CAASE4

residential fuel and have an objective apportioning factor of housing count (see Section 8). The remaining 51 apportioning factors for grid square number 97 are for source categories 6 through 56 and include the objective apportioning factors of housing, population, area, side length, and area-weighted inverse population density. Table 14 contains the record layout and a description of all variables included in the apportioning factor file output by CAASE4.

5.4 Job Control Language (JCL) and Deck Setup

An example of a deck setup configuration is illustrated in Figure 16. Using the Parkersburg-Marietta AQCR (#179) as an example study area, the associated JCL and input data cards are illustrated in Figure 19 and describe the following:

A. The main program is in source language form. For illustration purposes, one set of variable dimensions has been set to 100 (permitting the input of up to 99 grid squares per county for the counties being processed); the other set of variable dimensions has been set to 3 (permitting the input of overriding weighting factors for up to 3 source categories).

B. The CAASE4 subroutine (effectively the program that does all the work) is in object deck form.

C. The grid square file (output from CAASE2) is on tape as Fortran unit number 4. It is labeled "AQCR179.GRID". The volume and serial name is "DDDDDD".

D. The apportioning factor file will be written on tape as Fortran unit number 6. It will be labeled "AQCR179.APPORT.FACT". The volume and serial name is "JJJJJJ".

E. The county selector cards are on the installation dependent standard card input device. The counties to be processed include four in the

TABLE 14. OUTPUT RECORD LAYOUT FOR APPORTIONING FACTOR FILE, CAASE4

Position	Format	Variable Name	Definition
1 - 5	I5	ID	Grid square sequence number
6 - 11	F6.5	FRAC	Fraction of total area of grid square contained in this county
12 - 14	I3	ISTATE	FIPS state number for this grid square
15 - 34	5A4	SNAME	Name of state for this grid square
35 - 39	I5	ICNTY	FIPS county number for this grid square
40 - 59	5A4	CNAME	Name of county for this grid square
60 - 62	I3	IZONE	UTM zone of grid square coordinates (primary zone)
63 - 72	F10.0	X	UTM easting coordinate of lower left-hand corner of this grid square
73 - 82	F10.0	Y	UTM northing coordinate of lower left-hand corner of this grid square
83 - 92	F10.2	SIDE	Effective side length of this grid square for the area located in this county, i.e., the square root of the area contained in this county
93 - 102	F10.2	AREA	Area of this grid square contained in this county
103 - 830	56E13.5	FACTOR	Apportioning factors (including any overriding factors) for the 56 source categories for this grid square

```
//CAASE4 JOB RTI.C44.P01303,BURT,M=1,PRTY=0,T=1,P=100
//  EXEC FTGCLG
//C.SYSIN DD *
C
C     PROGRAM NAME: CAASE4 DRIVER
C
C     DRIVER FOR CAASE4 TO SET DIMENSIONS MUST BE RECOMPILED ANYTIME IT
C        IS NECESSARY TO SET DIMENSIONS
      DIMENSION SUMH(100),SUMP(100),X(100),Y(100),SIDE(100),FRAC(100),
     1 STATE(100),COUNTY(100),UTZONE(100),WGTFCT(100,3),ID(100),
     2 ISTATE(100),ICNTY(100),IZONE(100),ICAT(3),XINIT(3)
C
C     NDIM MUST BE AT LEAST ONE GREATER THAN THE NUMBER OF GRID SQUARES
C        IN THE COUNTY WITH THE MOST GRID SQUARES IN THE SET OF
         COUNTIES BEING PROCESSED WITH THIS COMPUTER RUN.
C
C
C     KDIM IS THE NUMBER OF SOURCE CATEGORIES TO BE OVERRIDDEN WITH
C     OVERRIDING WEIGHTING FACTORS DURING THIS RUN.
C
      NDIM = 99
      KDIM = 3
      CALL CAASE4(ID,SUMH,SUMP,X,Y,SIDE,FRAC,STATE,COUNTY,ISTATE,ICNTY,
     1UTZONE,IZONE,WFTFCT,ICAT,XINIT,NDIM,KDIM)
      CALL EXIT
      END
/*
//L.SYSIN DD *
                          ---SUBROUTINE OBJECT DECK---
/*
//*
//*   UNIT 4 IS THE GRID PRODUCED BY CAASE2.
//G.FT04F001 DD DSNAME=AQCR179.GRID,UNIT=TAPE,
//  LABEL=(1,SL),DCB=(RECFM=FB,LRECL=80,BLKSIZE=800,DEN=3),
//  DISP=(OLD,KEEP),VOLUME=SER=DDDDDD
//*
//*   UNIT 6 IS THE APPORTIONING FACTOR OUTPUT OF CAASE4.
//G.FT06F001 DD DSN=AQCR179.APPORT.FACT,UNIT=TAPE,LABEL=(1,SL),
//  DCB=(RECFM=FB,LRECL=830,BLKSIZE=8300,DEN=3),DISP=(NEW,KEEP),
//    RING=IN,VOL=SER=JJJJJJ
//G.SYSIN DD *
  009     ATHENS              39     OHIO                    0    0
  105     MEIGS               39     OHIO                    0    0
  115     MORGAN              39     OHIO                    0    0
  167     WASHINGTON          39     OHIO                    0    1
  035     JACKSON             54     WEST VIRGINIA           0    0
  073     PLEASANTS           54     WEST VIRGINIA           0    0
  095     TYLER               54     WEST VIRGINIA           0    0
  103     WETZEL              54     WEST VIRGINIA           0    0
  107     WOOD                54     WEST VIRGINIA           0    0
                              ----BLANK CARD----
/*
//
```

FIGURE 19. JCL AND INPUT DATA CARDS FOR CAASE4

state of Ohio and five in the state of West Virginia. No overriding weighting factors are to be input; therefore, no initializing factors are included in the input runstream. The detailed print option has been selected for Washington County, Ohio.

[At the installation where CAASE was developed, the catalogued procedure "FTGCLG" that will be executed (Fortran G, Compile, Link-Edit and Go - some object decks may be included in the input) assigns Fortran I/O devices 1, 2, and 3 to the card reader, card punch, and printer, respectively.]

5.5 Warnings and Limitations

The CAASE4 main program is used to set dimensions and to pass them to the CAASE4 subroutine as "variable dimensions." The variable NDIM is related to the number of grid squares; it must be as large as the largest number of grid squares in any county currently being processed. NDIM is passed to the CAASE4 subroutine as a variable dimension. The value assigned to the Fortran Dimension statements in the main program must be at least one larger than the value assigned to NDIM. (This is necessary because whenever the CAASE4 subroutine reads the grid square file, the end of the set of grid squares for one county is signaled by reading the first record of the next county, i.e., the county ID number changes. The end-of-file condition signals the end of the set of grid squares for the last county in the file.)

Analagous to the discussion concerning the variable NDIM and the number of grid squares, is the setting of the variable KDIM in the main program. KDIM is the variable used to set the dimensions for the number of source categories to be overridden. It must be at least as large as the largest number of categories to be overridden in any county currently being processed.

Selecting the detailed print option can produce a large number of printed pages. If this option is selected for a county, 24 lines (including vertical spacing) are printed for each grid square; a sufficient output page estimate must be included on the JCL "JOB" card.

All of the counties in the study area do not have to be processed during any particular CAASE4 run; however, those counties processed must be in the same order as processed by CAASE1 and CAASE2.

If source categories are to be overridden, a careful reading and a full understanding of Section 8 cannot be overemphasized.

6.0 CAASE5 PROGRAM

6.1 Program Description

The CAASE5 program performs the functions of calculating the emissions and allocating fuels and emissions to each grid square and source category combination.

In order to perform these functions, CAASE5 requires: the apportioning factor file output from CAASE4, current area source emission factors for the five primary pollutants, and the NEDS Area Source fuels (throughput) data (for each county to be processed). These data must be in the same format as the first five cards (A1 through A5) from the NEDS Area Source Input Form [EPA (DUR) 219, 3/72].

CAASE5 is structured such that a main program, with only a few lines of source code, is used to set the dimensions of the arrays for the variables used. (This is done to conserve computer core storage requirements.) The main program needs to be recompiled only if array sizes are to be increased. After defining the variable dimensions, the main program calls the subroutine CAASE5, which does all the work; CAASE5 calls other subroutines and passes the variable dimensions to them as necessary.

CAASE5 uses the fuels (throughput) totals and the emission factors to calculate county-total area source emissions in the same way as the NEDS programs.

Current area source emission factors are input by the user. The factors can be the national emission factors published by EPA or those developed by state or local agencies. Emission factors for highway motor vehicles are input directly; those for stationary sources and off-highway mobile sources are scaled for input. The scaling of the emission factor takes into account the scaling of the fuels data and units conversion. Emission factors are read in for each of the primary pollutants (TSP, SO_2, NO_x, HC, and CO) and area source category combinations.

Except in the case of highway motor vehicle emission factors, the factors are scaled and units are converted off-line. For example, if the emission factor is 20 pounds of TSP produced for each ton of bituminous coal burned for home heating, and the total tons burned is expressed in tens of tons on the NEDS area source form, then the factor read in should be 0.10 (10 scaling factor x 20 lbs/ton burned/2000 lbs/ton). The program subsequently multiplies the fuel total reported on the area source input form by the 0.10 factor yielding TSP emissions in tons. For those source-category/pollutant combinations where percent ash or sulfur content is used, the program automatically applies them during the on-line calculation. For those categories involving acres burned, the tons per acre reported is used in the calculation of emissions. (An example of a complete set of emission factors for input to CAASE5 is included in Section 6.2.)

A complete discussion of input, output, deck setup, and formats is included in Sections 6.2 through 6.4.

It is important to understand the sequence of steps performed by CAASE5 and the algorithms used; they are described as follows, and the steps are repeated for each county being processed. Initially, identification information for the state, county, study area, and the number of grid squares in the county are read in from cards. A card with labeling information is then read in and the subroutine READ1, which is described in Section 7.30, is called to read the county "fuels" totals from cards. These cards are coded in the same format as the first five cards on the NEDS Area Source Input Form [EPA (DUR) 219, 3/72]. If READ1 does not return an error condition, processing continues. The apportioning factor file output from the CAASE4 program is then read.

At this point in the processing, the apportioning factors are not fractions that can be used as coefficients for the county totals of fuels and emissions; that is, each is a calculated value, one for each grid square and source category combination. Using any one source category and county as an example of the procedure, and supposing that the county contained 50 grid squares, then the steps are as follows: the apportioning factors for all 50 grid squares for this source category are summed; (this becomes the denominator of a fraction). CAASE5 then allocates to the first grid square a fractional portion of the county total fuels for this source category; the fraction is the apportioning factor for the first grid square divided by the sum of the 50 apportioning factors for this source category for this county. The processing proceeds until an allocation has been made (for this source category) to each of the 50 grid squares.

In a sense, the apportioning factors output from CAASE4 appear dimensionless to CAASE5. Regardless of the numeric range of the apportioning factors for a source category, fractions are calculated by CAASE5. A summation of these fractions for a source category and for all grid squares in a county will yield unity. (After calculating county totals of emissions for each pollutant and source category combination, CAASE5 allocates them to the grid squares in the same manner as was done with the fuels.)

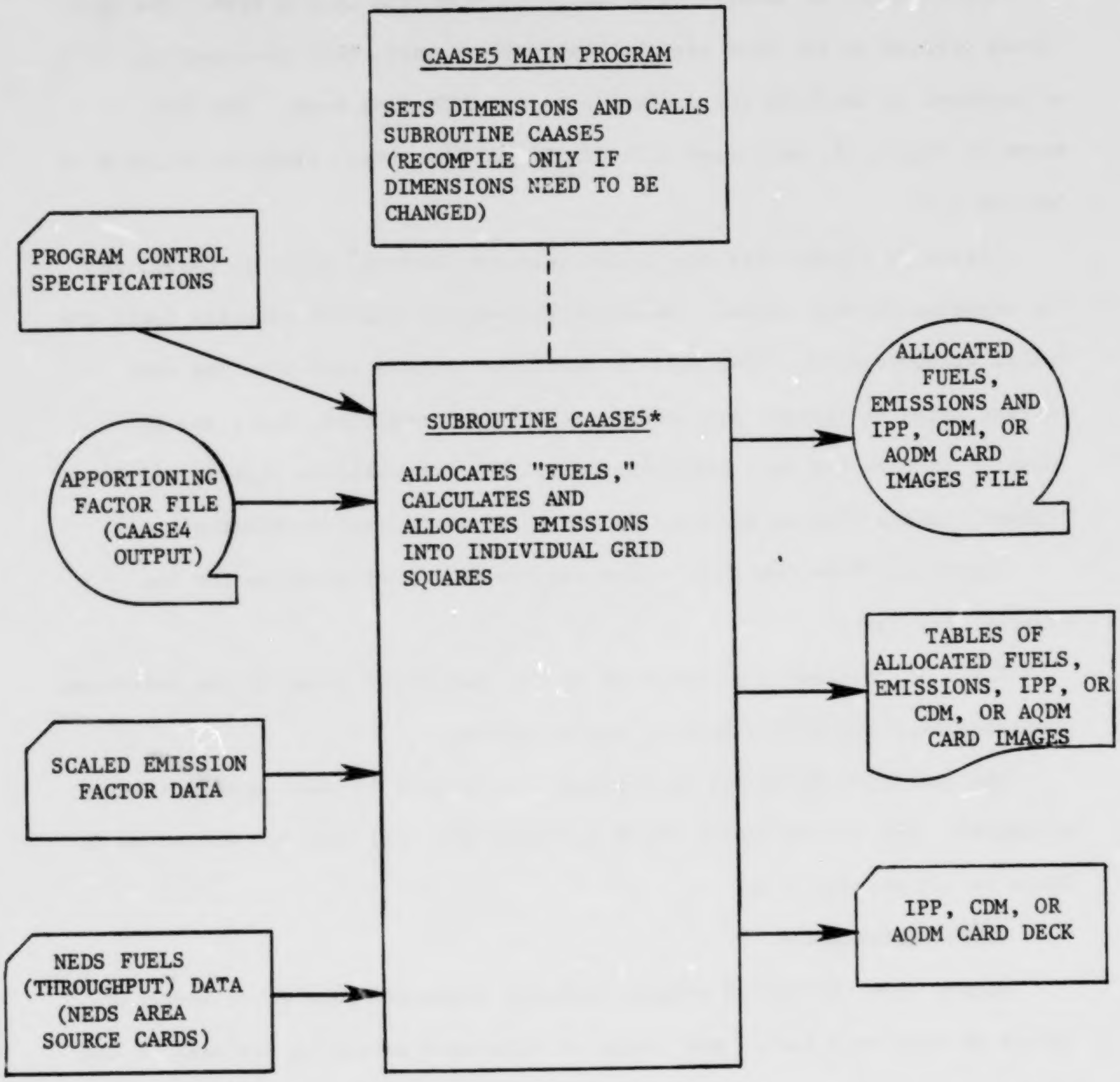
After the fuels have been allocated for all categories, the subroutine OUTPT1 is called which causes the printing of tables. (OUTPT1 is described in Section 7.31.) The CAASE5 program then calculates total emissions for each of the five primary pollutants (TSP, SO_2, NO_X, HC, and CO) for each of the fuel categories. The CAASE5 program handles the highway motor vehicle source categories in the same manner as the AEROS-NADB program for the NEDS system. Measured vehicle miles by vehicle class is used, if available, and the ratios for vehicle classes are calculated using estimates of miles per gallon of fuel used for each of the different vehicle classes. The emissions are then allocated one pollutant at a time to limit the computer core storage requirements. The emissions for all area source emission categories for the county are summed and printed for comparison with the total emissions calculated by the NEDS system for area sources. The TSP, SO_2, NO_X, HC, and CO emissions for all source categories are summed for each grid square and saved for the dispersion modeling input cards to be output later using the OUTPT3 subroutine. (OUTPT3 is described in Section 7.33.) The allocated emissions are printed in tabular form using the OUTPT2 subroutine. (OUTPT2 is described in Section 7.32.) After allocated emissions are output for all five pollutants, the dispersion modeling input card images are produced by calling the OUTPT3 subroutine. A formatted tape is written containing all table entries and is described, in detail, in Section 6.3.

Logical flowcharts and source language listings for CAASE5 and its subroutines are included in Appendix E.

Figure 20 is a system flowchart of the CAASE5 program.

6.2 Input Information

Emission factors and a dispersion model selector card are read; they will be used for all counties to be processed. For each county to be processed, a county selector card, a heading card for labeling output, and county-total area source fuels (throughput) data are read. The fuels (throughput) data is input in the same format as the first five cards (A1 through A5) on the NEDS Area Source Input Form [EPA (DUR) 219, 3/72]. Subroutine READ1 performs the function of reading the area source fuels (throughput) cards. READ1 also calculates the "light truck, gasoline fuel" fuels total for the county. (See Section 7.30 for the alogrithm used.) This source category is not directly reported on the area source form; the algorithm used by READ1 was obtained from EPA/NADB.


CAASE5 MAIN PROGRAM
SETS DIMENSIONS AND CALLS SUBROUTINE CAASE5 (RECOMPILE ONLY IF DIMENSIONS NEED TO BE CHANGED)
PROGRAM CONTROL SPECIFICATIONS
APPORTIONING FACTOR FILE (CAASE4 OUTPUT)
SCALED EMISSION FACTOR DATA
NEDS FUELS (THROUGHPUT) DATA (NEDS AREA SOURCE CARDS)
SUBROUTINE CAASE5*
ALLOCATES "FUELS," CALCULATES AND ALLOCATES EMISSIONS INTO INDIVIDUAL GRID SQUARES
ALLOCATED FUELS, EMISSIONS AND IPP, CDM, OR AQDM CARD IMAGES FILE
TABLES OF ALLOCATED FUELS, EMISSIONS, IPP, OR CDM, OR AQDM CARD IMAGES
IPP, CDM, OR AQDM CARD DECK

*This is "effectively" the main program; the main (driver) CAASE5 program is used only to set dimensions and call this subroutine.

----- = Optional

FIGURE 20. SYSTEM FLOWCHART OF CAASE5 PROGRAM

Figure 21 is an example of a completed NEDS Area Source Form. The data values entered on the form are the Washington County, Ohio inventory for 1972 as reported to EPA/NADB for inclusion in the NEDS data base. The data, as shown in Figure 21, were used with CAASE5 for the output examples included in Section 6.3.

Figure 22 illustrates the scaled emission factors* input to CAASE5 for the examples in this manual. Emission factors for highway vehicles fuels are scaled within CAASE5. (The user is cautioned to make sure that the most current emission factors are used.) For highway vehicles, there are 16 emission factors for each pollutant; there are four vehicle classes and four highway classes with an emission factor assigned to each combination.

Figure 23 shows the input order and the deck configuration for the various card types.

Table 15 contains a description of the card types input in the runstream, their formats, and definitions of the variables.

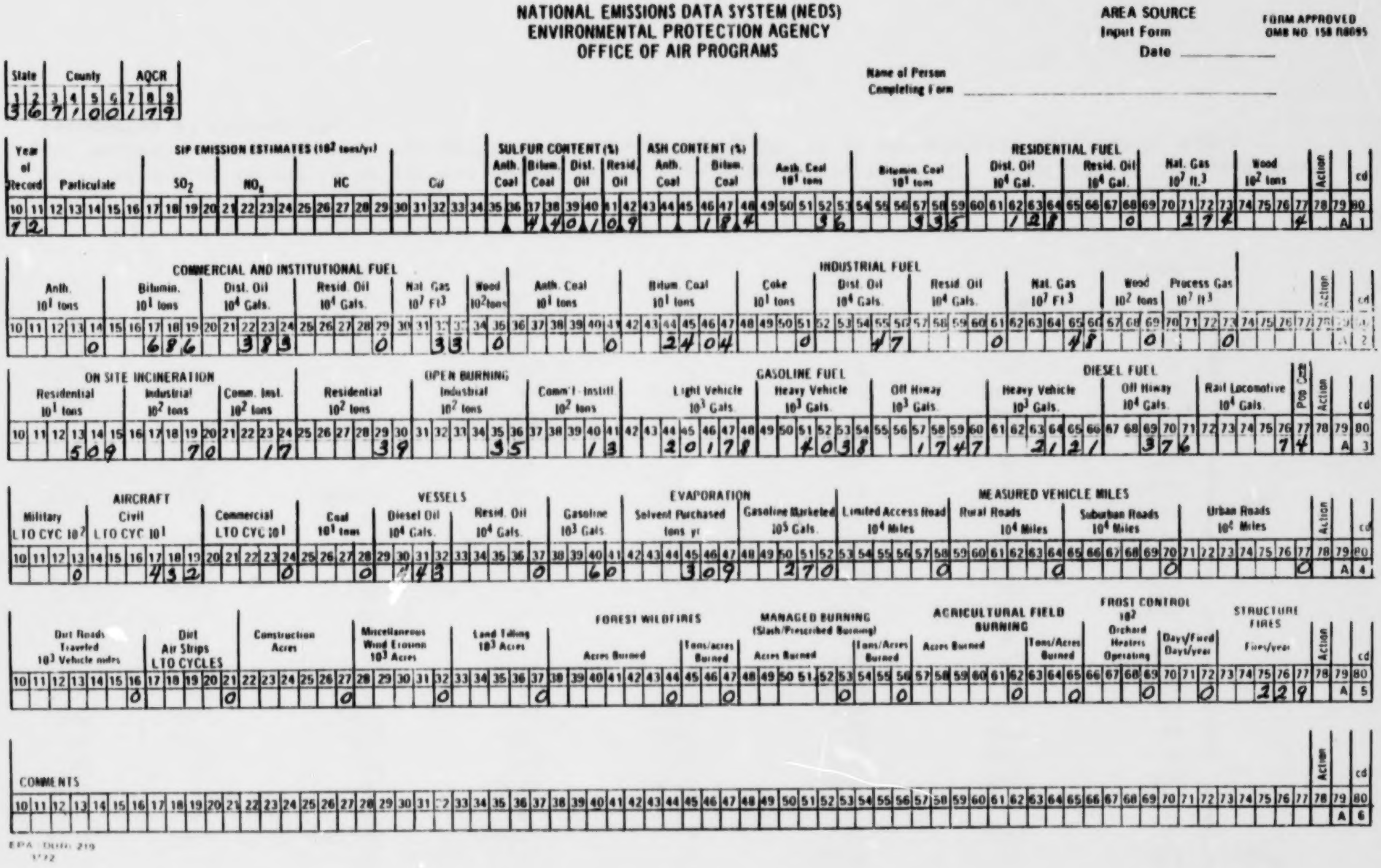
The apportioning factor file output from CAASE4 is used as direct input to CAASE5. The record layout and description for this file are contained in Table 14 (in Section 5.3).

6.3 Output Information

Output from the CAASE5 program includes diagnostic and error messages, tables of allocated fuels, and tables of allocated emissions for each of the five primary pollutants. A card deck (or card images) is produced in the input format for the IPP, CDM, or AQDM dispersion models. A formatted tape is written containing table entries, and the card images are also written on this

---

*The CAASE5 program logic automatically takes into account the ash and sulfur content for the appropriate source categories.



NATIONAL EMISSIONS DATA SYSTEM (NEDS)
ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF AIR PROGRAMS

AREA SOURCE
Input Form
Date ____________

FORM APPROVED
OMB NO. 158 R0095

Name of Person Completing Form ____________________

State	County	AQCR
1 2	3 4 5 6	7 8 9
3 6	7 1 0 0	1 7 9

Year of Record	SIP EMISSION ESTIMATES (10² tons/yr) Particulate	SO₂	NOₓ	HC	CO	SULFUR CONTENT (%) Anth. Coal	Bitum. Coal	Dist. Oil	Resid. Oil	ASH CONTENT (%) Anth. Coal	Bitum. Coal	RESIDENTIAL FUEL Anth. Coal 10¹ tons	Bitumin. Coal 10¹ tons	Dist. Oil 10⁴ Gal.	Resid. Oil 10⁴ Gal.	Nat. Gas 10⁷ ft.³	Wood 10² tons	Action		cd
10–11	12–16	17–20	21–24	25–29	30–34	35–36	37–38	39–40	41–42	43–45	46–48	49–53	54–59	60–64	65–68	69–73	74–77	78	79	80
72							44	01	09		184	36	335	128	0	274	4		A	1

COMMERCIAL AND INSTITUTIONAL FUEL Anth. 10¹ tons	Bitumin. 10¹ tons	Dist. Oil 10⁴ Gals.	Resid. Oil 10⁴ Gals.	Nat. Gas 10⁷ Ft³	Wood 10² tons	INDUSTRIAL FUEL Anth. Coal 10¹ tons	Bitum. Coal 10¹ tons	Coke 10¹ tons	Dist. Oil 10⁴ Gals.	Resid. Oil 10⁴ Gals.	Nat. Gas 10⁷ Ft³	Wood 10² tons	Process Gas 10⁷ ft³		Action		cd
10–14	15–19	20–24	25–29	30–33	34–35	36–41	42–47	48–51	52–56	57–61	62–66	67–69	70–73	74–77	78	79	80
0	686	383	0	33	0	0	2404	0	47	0	48	0	0			A	2

ON SITE INCINERATION Residential 10¹ tons	Industrial 10² tons	Comm. Inst. 10² tons	OPEN BURNING Residential 10² tons	Industrial 10² tons	Comm'l - Instit'l 10² tons	GASOLINE FUEL Light Vehicle 10³ Gals.	Heavy Vehicle 10³ Gals.	Off Hiway 10³ Gals.	DIESEL FUEL Heavy Vehicle 10³ Gals.	Off Hiway 10⁴ Gals.	Rail Locomotive 10⁴ Gals.	Pop Cat	Action		cd
10–15	16–20	21–24	25–30	31–36	37–41	42–48	49–54	55–60	61–66	67–71	72–76	77	78	79	80
509	70	17	39	35	13	20178	4038	1747	2121	376	7	4		A	3

AIRCRAFT Military LTO CYC 10²	Civil LTO CYC 10¹	Commercial LTO CYC 10¹	VESSELS Coal 10¹ tons	Diesel Oil 10⁴ Gals.	Resid. Oil 10⁴ Gals.	EVAPORATION Gasoline 10³ Gals.	Solvent Purchased tons yr	Gasoline Marketed 10⁵ Gals.	MEASURED VEHICLE MILES Limited Access Road 10⁴ Miles	Rural Roads 10⁴ Miles	Suburban Roads 10⁴ Miles	Urban Roads 10⁴ Miles	Action		cd
10–13	14–19	20–24	25–28	29–32	33–37	38–41	42–47	48–52	53–58	59–64	65–70	71–77	78	79	80
0	432	0	0	243	0	60	309	270	0	0	0	0		A	4

Dirt Roads Traveled 10³ Vehicle miles	Dirt Air Strips LTO CYCLES	Construction Acres	Miscellaneous Wind Erosion 10³ Acres	Land Tilling 10³ Acres	FOREST WILDFIRES Acres Burned	Tons/acres Burned	MANAGED BURNING (Slash/Prescribed Burning) Acres Burned	Tons/Acres Burned	AGRICULTURAL FIELD BURNING Acres Burned	Tons/Acres Burned	FROST CONTROL 10² Orchard Heaters Operating	Days/Fired Days/year	STRUCTURE FIRES Fires/year	Action		cd
10–16	17–21	22–27	28–32	33–37	38–44	45–47	48–53	54–56	57–62	63–65	66–69	70–72	73–77	78	79	80
0	0	0	0	0	0	0	0	0	0	0	0	0	229		A	5

COMMENTS	Action		cd
10–77	78	79	80
		A	6

EPA (Dur) 219
1/72

FIGURE 21. NEDS AREA SOURCE INPUT FORM FOR WASHINGTON COUNTY, OHIO (1972)

.05	.10	.05	.115	.05	1.25	.01	.029	TSP*
.075	.115	.05	1.25	.01	.065	.001	.075	
.115	.05	1.25	.1	.16	.4	.4	.8	
.8	.8	0.	0.	0.	.00535	0.	.1665	
.125	.995	.002845	.00895	.1	.12	.0965	0.	
0.	0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	.0085	.0085	.0085	.0001	.054	
.184	.19	.72	.795	.003	.075	.1925	.19	SO_2
.72	.795	.003	.075	.1925	.19	.019	.76	
.795	.003	.075	.01	.0025	.125	.125	.05	
.05	.05	0.	0.	0.	.0028	0.	.149	
.285	.19	.000565	.0128	.25	.15	1.43	.00315	
0.	0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	.00005	.0001	
.015	.015	.06	.2	.4	.5	.05	.046	NO_X
.3	.3	.6	.5	.075	.075	.005	.3	
.3	.9	.5	1.15	.005	.15	.15	.3	
.3	.3	0.	0.	0.	.061	0.	1.845	
1.85	. 478	.00257	.126	.015	1.12	.209	.0137	
0.	0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	.002	.001	.001	0.	.0047	
.0125	.1	.015	.015	.04	1.	.001	.01	HC
.015	.015	.04	1.	.001	.005	.0001	.015	
.015	.015	1.	.15	.45	.25	.25	1.5	
1.5	1.5	0.	0.	0.	.172	0.	.202	
.47	2.315	.0126	.1655	.1	.294	.0145	.4655	
1.	1.1	0.	0.	0.	0.	0.	0.	
0.	0.	0.	.012	.01	.01	.0215	.014	

---

*Order of scaled factor is by row and column in the same order as in Table 12. Zero fillers are used when the emission factor has not been determined e.g., category 48, or is not directly applicable, e.g., categories 43 through 46.

FIGURE 22. SCALED AREA SOURCE EMISSION FACTORS USED AS INPUT TO CAASE5 FOR THE CAASE EXAMPLES.

.45	.45	.025	.02	.1	1.	.03	.036	CO
.02	.02	.1	1.	.01	.01	.0025	.02	
.02	.085	1.	0.	1.35	.575	.575	4.25	
4.25	4.25	0.	0.	0.	1.95	0.	.52	
.65	2.485	.072	.3415	.45	.392	.007	1.48	
0.	0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	.07	.03	.05	.011	.122	
.54	.54	1.2	2.2	.54	.54	1.2	2.2	TSP+
.54	.54	1.2	2.2	.54	.54	1.2	2.2	
.13	.18	.36	2.8	.13	.18	.36	2.8	SO_2
.13	.18	.36	2.8	.13	.18	.36	2.8	
4.9	5.8	12.5	28.3	4.9	5.8	12.5	27.9	NO_X
4.6	5.5	11.7	26.7	4.1	4.9	10.5	22.3	
5.8	9.3	18.6	2.3	5.8	9.3	18.6	2.4	HC
6.2	10.	20.6	2.8	8.3	13.1	29.1	4.	
30.7	38.3	136.7	8.9	30.7	38.3	136.7	10.5	CO
37.3	46.1	159.4	15.	64.1	78.	254.2	31.1	

[+] Order of factors is by row and column for vehicle class and highway class respectively.

FIGURE 22. SCALED AREA SOURCE EMISSION FACTORS USED AS INPUT TO CAASE5 FOR THE CAASE EXAMPLES (CONT.)

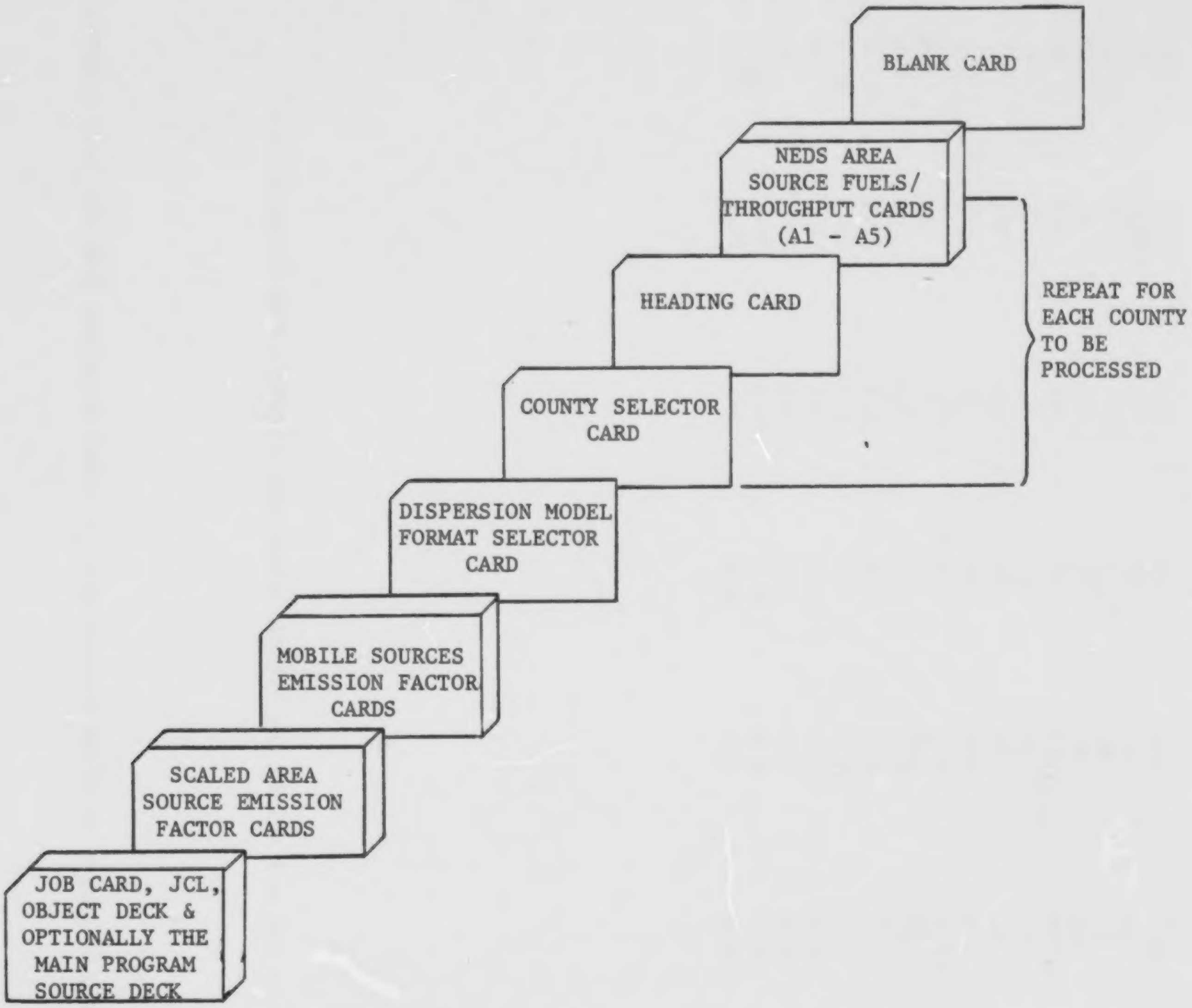

BLANK CARD
NEDS AREA SOURCE FUELS/ THROUGHPUT CARDS (A1 - A5)
REPEAT FOR EACH COUNTY TO BE PROCESSED
HEADING CARD
COUNTY SELECTOR CARD
DISPERSION MODEL FORMAT SELECTOR CARD
MOBILE SOURCES EMISSION FACTOR CARDS
SCALED AREA SOURCE EMISSION FACTOR CARDS
JOB CARD, JCL, OBJECT DECK & OPTIONALLY THE MAIN PROGRAM SOURCE DECK

FIGURE 23. INPUT DECK CONFIGURATION FOR CAASE5 PROGRAM

TABLE 15. INPUT CARD LAYOUT, CAASE5

Card Type	Card Columns	Format	Variable Name	Description
SCALED EMISSION FACTOR CARD	1 - 80	8F10.0	EMFAC1-EMFAC5	8 emission factors per card for 56 source categories, 7 cards per pollutant, 5 pollutants
MOBILE SOURCES EMISSION FACTOR CARD	1 - 80	8F10.0	EFHV	8 emission factors per card for 4 vehicle classes, 4 road types, 2 cards per pollutant, 5 pollutants
DISPERSION MODEL FORMAT SELECTOR CARD	1 - 5	I5	IWANT	Code denoting subroutine OUTPT3 output format IWANT = 1 IPP = 2 CDM = 3 AQDM
COUNTY SELECTOR CARD*	1 - 10	F10.0	XSTATE	FIPS state code of selected state
	11 - 20	I10	ICNTY	FIPS county code of selected county
	21 - 30	F10.0	XAQCR	Numeric code number of selected study area
	31 - 40	I10	NAREAS	Number of grid squares in selected county
	41 - 46	6X	--	Blank
	47 - 50	A4	CNTY	Name of selected county
	51 - 55	I5	KOUNTY	NEDS county code of selected county
	56 - 60	I5	KSTATE	NEDS state code of selected state
	61 - 69	9X	--	Blank
	70	A1	IPOLIT	Political subdivision of selected study area

---

*For the processing of more than one county, repeat card setup from this card type through card type fuels (throughput) totals.

TABLE 15. INPUT CARD LAYOUT, CAASE5 (CONT.)

Card Type	Card Columns	Format	Variable Name	Description
COUNTY SELECTOR CARD (CONT.)	71 - 77	7X	--	Blank
	78 - 80	A3	IREGN	Alpha code number of selected study area
HEADING CARD	1 - 80	20A4	HDG	Output page heading including name of selected county, state and any other pertinent identifying information
FUELS (THROUGHPUT) CARD	1 - 80	See NEDS AREA SOURCE INPUT FORMAT		NEDS area source fuels (throughput) cards A1 - A5
RUN DELIMITER CARD	1 - 80	80X	--	Blank - No more counties to be processed

tape. County totals, by source category and pollutant combination, are both printed and written on tape. Fuel totals from the area source input cards are printed for convenience and visual checking. Figure 24 is an example of a printout of the NEDS area source fuels (throughput) data read in for Washington County, Ohio.

The OUTPT1 subroutine outputs tables of allocated fuels (throughput) for each source category and grid square combination; Figures 25 through 29 are examples of output Tables 1 through 5 of allocated fuels for Washington County, Ohio.

The OUTPT2 subroutine outputs tables of allocated emissions for each source category and grid square combination. The OUTPT2 subroutine is called five times for each county, that is, once for each pollutant. Figures 30 through 34 are examples of output Tables 1 through 5 of allocated emissions (particulates) for Washington County, Ohio. Allocated emissions for the other four pollutants are output in the same format as the particulates.

Figure 35 is an example printout of county-total emissions for all source category and pollutant combinations for Washington County, Ohio. The county emissions totals calculated by CAASE5 for each pollutant is also printed.

Figure 36 is an example printout produced by the OUTPT3 subroutine. In this example, dispersion modeling input card images are in the IPP format. Cards are also punched, and the card images are written on the formatted CAASE5 output tape. (The OUTPT3 subroutine is described in Section 7.33.)

The formats of the CAASE5 output tape records are contained in Table 16; a description of the contained variables is given in Table 17. Tables 16 and 17 also include the sources of each of the various record types. OUTPT1 and OUTPT2 write a header record each time the subroutines are called; each header record is followed by detailed records containing allocated fuels or allocated

```
WASHINGTON COUNTY, OHIO  (PARKERSBURG-MARIETTA AQCR - NEDS 1972) TEST 1/78

FUEL TOTALS READ IN FOLLOW - (NOTE THAT READ1 ROUTINE CALCULATED THE LGT TRUCKS CATEGORY (NO.28) BY
APPORTIONING FROM LGT DUTY GAS (NO. 27) AND HVY DUTY GAS TRUCKS (NO.29))

   36.0     335.0    128.0       0.0     274.0       4.0        0.0       686.0      383.0      0.0
   33.0       0.0      0.0    2404.0       0.0      47.0        0.0        48.0        0.0      0.0
  509.0      70.0     17.0      39.0      35.0      13.0    17716.3      3564.1     2935.6   1747.0
 2121.0     376.0      7.0       0.0     432.0       0.0        0.0       443.0        0.0     60.0
  309.0     270.0      0.0       0.0       0.0       0.0        0.0         0.0        0.0      0.0
    0.0       0.0      0.0       0.0       0.0     229.0

FOOTNOTE:  CATEGORIES BY ROW IN SAME ORDER AS AREA SOURCE NEDS FORM AND OUTPUT TABLES
```

FIGURE 24. EXAMPLE PRINTOUT OF AREA SOURCE INPUT DATA, CAASE5

```
WASHINGTON COUNTY, OHIO  (PARKERSBURG-MARIETTA AQCR - NEDS 1972) TEST 1/78

          COUNTY-WIDE AREA SOURCE DATA USED IN CALCULATING EMISSIONS BY SOURCE CATEGORY FOR APPORTIONING

                    SULFUR CONTENT:

                         ANTHRACITE COAL           =      0.0 PERCENT
                         BITUMINOUS COAL           =      4.4 PERCENT
                         DISTILLATE OIL            =      0.1 PERCENT
                         RESIDUAL OIL              =      0.9 PERCENT

                    ASH CONTENT:

                         ANTHRACITE COAL           =      0.0 PERCENT
                         BITUMINOUS COAL           =     18.4 PERCENT

                  ********************************************************************

                    FOREST WILDFIRES               =      0.0 TONS PER ACRE

                    MANAGED BURNING                =      0.0 TONS PER ACRE

                    AGRICUL. FIELD BURNING         =      0.0 TONS PER ACRE

                    FROST CONTROL                  =      0.0 TONS PER ACRE

                  ********************************************************************

                                   POPULATION CODE =  4
```

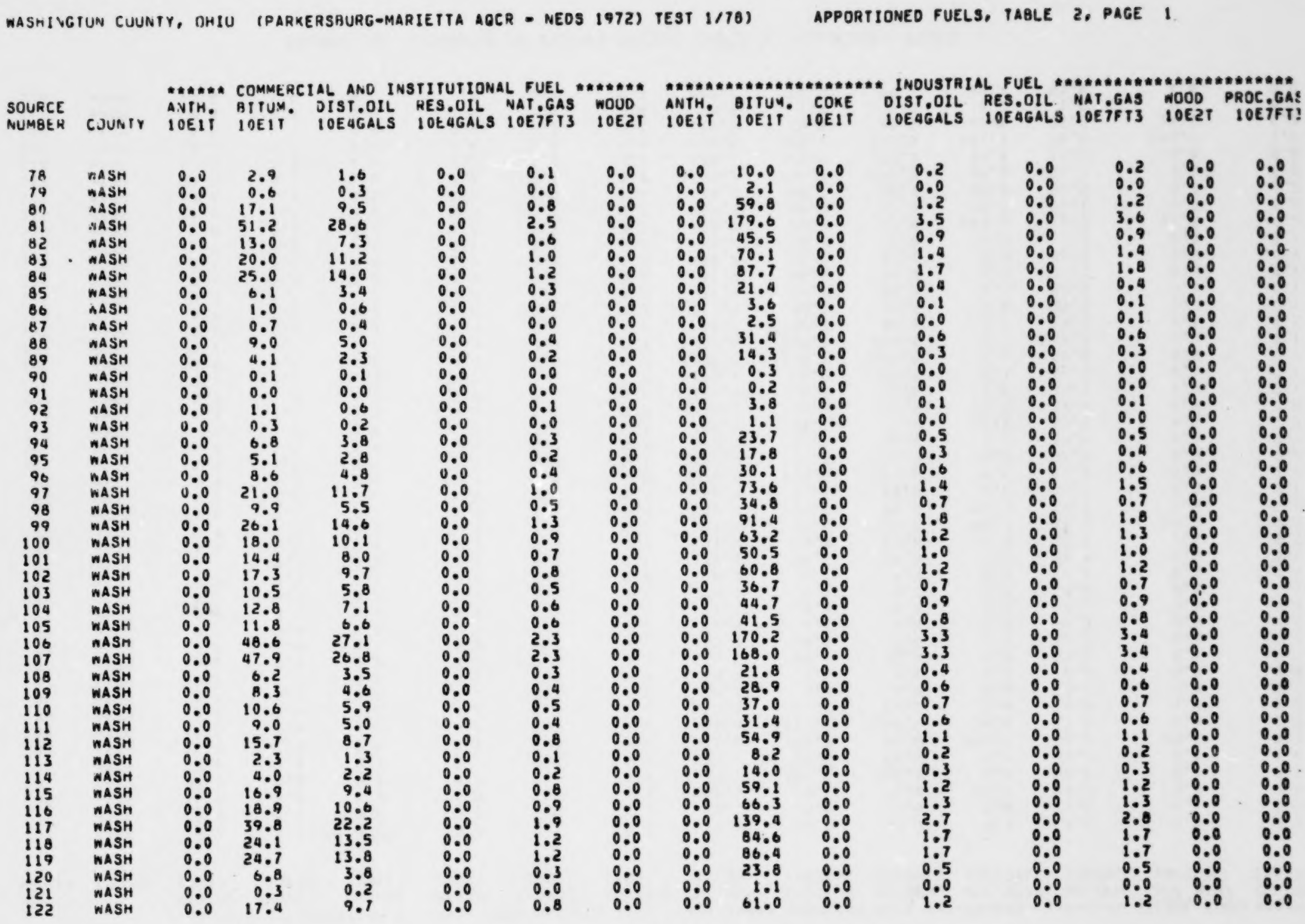
FIGURE 24. EXAMPLE PRINTOUT OF AREA SOURCE INPUT DATA, CAASE5 (CONT.)

```
WASHINGTUN COUNTY, UHIO  (PARKERSBURG-MARIETTA AQCR - NEDS 1972) TEST 1/78)      APPORTIONED FUELS, TABLE  1, PAGE  1

                                                                   ****************** RESIDENTIAL FUEL *****************
SUURCE           POLIT              COORDINATES                    ANTH.     BITUM.     DIST.OIL    RES.OIL      NAT.GAS   WOOD
NUMBER  HEGIUN   JURIS   COUNTY    X(KM)    Y(KM)     (SQ.KM)     10E1T     10E1T      10E4GALS    10E4GALS     10E7FT3   10E2T

   78    179             WASH      421.0   4335.0      12.30       0.1        1.4        0.5         0.0           1.1      0.0
   79    179             WASH      437.0   4335.0       1.16       0.0        0.3        0.1         0.0           0.2      0.0
   80    179             WASH      437.0   4343.0      35.39       0.8        7.9        3.0         0.0           6.4      0.1
   81    179             WASH      445.0   4347.0      10.65       2.6       24.4        9.3         0.0          20.0      0.3
   82    179             WASH      449.0   4347.0       2.49       0.7        6.3        2.4         0.0           5.2      0.1
   83    179             WASH      421.0   4351.0     147.29       1.1        9.9        3.8         0.0           8.1      0.1
   84    179             WASH      437.0   4351.0      64.00       1.2       11.5        4.4         0.0           9.4      0.1
   85    179             WASH      445.0   4351.0      16.00       0.3        2.7        1.1         0.0           2.2      0.0
   86    179             WASH      449.0   4351.0       3.74       0.0        0.5        0.2         0.0           0.4      0.0
   87    179             WASH      453.0   4351.0       1.98       0.0        0.3        0.1         0.0           0.3      0.0
   88    179             WASH      461.0   4351.0       4.95       0.4        4.1        1.6         0.0           3.4      0.0
   89    179             WASH      469.0   4351.0       4.30       0.2        1.9        0.7         0.0           1.5      0.0
   90    179             WASH      485.0   4351.0       1.00       0.0        0.1        0.0         0.0           0.0      0.0
   91    179             WASH      451.0   4352.0       0.18       0.0        0.0        0.0         0.0           0.0      0.0
   92    179             WASH      449.0   4353.0       4.00       0.1        0.5        0.2         0.0           0.4      0.0
   93    179             WASH      451.0   4353.0       1.19       0.0        0.1        0.1         0.0           0.1      0.0
   94    179             WASH      445.0   4355.0      16.00       0.3        3.1        1.2         0.0           2.5      0.0
   95    179             WASH      449.0   4355.0      14.44       0.2        2.3        0.9         0.0           1.8      0.0
   96    179             WASH      437.0   4359.0      64.00       0.4        3.9        1.5         0.0           3.2      0.0
   97    179             WASH      445.0   4359.0      64.00       1.0        9.0        3.4         0.0           7.3      0.1
   98    179             WASH      453.0   4359.0      14.18       0.5        4.4        1.7         0.0           3.6      0.1
   99    179             WASH      457.0   4359.0       3.04       1.3       12.2        4.7         0.0          10.0      0.1
  100    179             WASH      461.0   4359.0       3.75       1.1       10.5        4.0         0.0           8.6      0.1
  101    179             WASH      465.0   4359.0      15.15       0.7        6.7        2.6         0.0           5.5      0.1
  102    179             WASH      469.0   4359.0      61.71       0.9        8.2        3.2         0.0           6.7      0.1
  103    179             WASH      477.0   4359.0      35.86       0.6        5.4        2.1         0.0           4.5      0.1
  104    179             WASH      453.0   4363.0      16.00       0.6        5.6        2.1         0.0           4.6      0.1
  105    179             WASH      457.0   4363.0       4.00       0.6        6.0        2.3         0.0           4.9      0.1
  106    179             WASH      459.0   4363.0       3.95       3.1       28.8       11.0         0.0          23.6      0.3
  107    179             WASH      461.0   4363.0       3.88       2.1       19.6        7.5         0.0          16.0      0.2
  108    179             WASH      463.0   4363.0       4.00       0.4        3.4        1.3         0.0           2.7      0.0
  109    179             WASH      465.0   4363.0      16.00       0.4        3.7        1.4         0.0           3.1      0.0
  110    179             WASH      457.0   4365.0       4.00       0.7        6.1        2.3         0.0           5.0      0.1
  111    179             WASH      459.0   4365.0       4.00       0.5        4.9        1.9         0.0           4.0      0.1
  112    179             WASH      461.0   4365.0       4.00       0.9        8.7        3.3         0.0           7.1      0.1
  113    179             WASH      463.0   4365.0       4.00       0.1        1.1        0.4         0.0           0.9      0.0
  114    179             WASH      421.0   4367.0      55.10       0.2        1.9        0.7         0.0           1.5      0.0
  115    179             WASH      437.0   4367.0      60.69       0.8        7.6        2.9         0.0           6.3      0.1
  116    179             WASH      445.0   4367.0      64.00       0.9        8.4        3.2         0.0           6.9      0.1
  117    179             WASH      453.0   4367.0      64.00       2.0       18.7        7.2         0.0          15.3      0.2
  118    179             WASH      461.0   4367.0      64.00       1.2       11.4        4.3         0.0           9.3      0.1
  119    179             WASH      469.0   4367.0     254.55       1.3       12.1        4.6         0.0           9.9      0.1
  120    179             WASH      485.0   4367.0      47.13       0.4        3.7        1.4         0.0           3.0      0.0
  121    179             WASH      493.0   4367.0       1.53       0.0        0.2        0.1         0.0           0.2      0.0
  122    179             WASH      437.0   4375.0      53.42       0.9        8.7        3.3         0.0           7.1      0.1
```

FIGURE 25. EXAMPLE OF CAASE5 OUTPUT TABLE 1, ALLOCATED FUELS



```
WASHINGTON COUNTY, OHIO  (PARKERSBURG-MARIETTA AQCR - NEDS 1972) TEST 1/78)      APPORTIONED FUELS, TABLE  2, PAGE  1


                         ****** COMMERCIAL AND INSTITUTIONAL FUEL *******  ********************** INDUSTRIAL FUEL ************************
SOURCE                   ANTH.  BITUM.  DIST.OIL   RES.OIL   NAT.GAS  WOOD   ANTH.  BITUM.  COKE   DIST.OIL   RES.OIL   NAT.GAS  WOOD   PROC.GAS
NUMBER   COUNTY          10E1T  10E1T   10E4GALS   10E4GALS  10E7FT3  10E2T  10E1T  10E1T   10E1T  10E4GALS   10E4GALS  10E7FT3  10E2T  10E7FT3


   78     WASH            0.0     2.9      1.6        0.0       0.1    0.0    0.0    10.0    0.0      0.2        0.0       0.2    0.0     0.0
   79     WASH            0.0     0.6      0.3        0.0       0.0    0.0    0.0     2.1    0.0      0.0        0.0       0.0    0.0     0.0
   80     WASH            0.0    17.1      9.5        0.0       0.8    0.0    0.0    59.8    0.0      1.2        0.0       1.2    0.0     0.0
   81     WASH            0.0    51.2     28.6        0.0       2.5    0.0    0.0   179.6    0.0      3.5        0.0       3.6    0.0     0.0
   82     WASH            0.0    13.0      7.3        0.0       0.6    0.0    0.0    45.5    0.0      0.9        0.0       0.9    0.0     0.0
   83     WASH            0.0    20.0     11.2        0.0       1.0    0.0    0.0    70.1    0.0      1.4        0.0       1.4    0.0     0.0
   84     WASH            0.0    25.0     14.0        0.0       1.2    0.0    0.0    87.7    0.0      1.7        0.0       1.8    0.0     0.0
   85     WASH            0.0     6.1      3.4        0.0       0.3    0.0    0.0    21.4    0.0      0.4        0.0       0.4    0.0     0.0
   86     WASH            0.0     1.0      0.6        0.0       0.0    0.0    0.0     3.6    0.0      0.1        0.0       0.1    0.0     0.0
   87     WASH            0.0     0.7      0.4        0.0       0.0    0.0    0.0     2.5    0.0      0.0        0.0       0.1    0.0     0.0
   88     WASH            0.0     9.0      5.0        0.0       0.4    0.0    0.0    31.4    0.0      0.6        0.0       0.6    0.0     0.0
   89     WASH            0.0     4.1      2.3        0.0       0.2    0.0    0.0    14.3    0.0      0.3        0.0       0.3    0.0     0.0
   90     WASH            0.0     0.1      0.1        0.0       0.0    0.0    0.0     0.3    0.0      0.0        0.0       0.0    0.0     0.0
   91     WASH            0.0     0.0      0.0        0.0       0.0    0.0    0.0     0.2    0.0      0.0        0.0       0.0    0.0     0.0
   92     WASH            0.0     1.1      0.6        0.0       0.1    0.0    0.0     3.8    0.0      0.1        0.0       0.1    0.0     0.0
   93     WASH            0.0     0.3      0.2        0.0       0.0    0.0    0.0     1.1    0.0      0.0        0.0       0.0    0.0     0.0
   94     WASH            0.0     6.8      3.8        0.0       0.3    0.0    0.0    23.7    0.0      0.5        0.0       0.5    0.0     0.0
   95     WASH            0.0     5.1      2.8        0.0       0.2    0.0    0.0    17.8    0.0      0.3        0.0       0.4    0.0     0.0
   96     WASH            0.0     8.6      4.8        0.0       0.4    0.0    0.0    30.1    0.0      0.6        0.0       0.6    0.0     0.0
   97     WASH            0.0    21.0     11.7        0.0       1.0    0.0    0.0    73.6    0.0      1.4        0.0       1.5    0.0     0.0
   98     WASH            0.0     9.9      5.5        0.0       0.5    0.0    0.0    34.8    0.0      0.7        0.0       0.7    0.0     0.0
   99     WASH            0.0    26.1     14.6        0.0       1.3    0.0    0.0    91.4    0.0      1.8        0.0       1.8    0.0     0.0
  100     WASH            0.0    18.0     10.1        0.0       0.9    0.0    0.0    63.2    0.0      1.2        0.0       1.3    0.0     0.0
  101     WASH            0.0    14.4      8.0        0.0       0.7    0.0    0.0    50.5    0.0      1.0        0.0       1.0    0.0     0.0
  102     WASH            0.0    17.3      9.7        0.0       0.8    0.0    0.0    60.8    0.0      1.2        0.0       1.2    0.0     0.0
  103     WASH            0.0    10.5      5.8        0.0       0.5    0.0    0.0    36.7    0.0      0.7        0.0       0.7    0.0     0.0
  104     WASH            0.0    12.8      7.1        0.0       0.6    0.0    0.0    44.7    0.0      0.9        0.0       0.9    0.0     0.0
  105     WASH            0.0    11.8      6.6        0.0       0.6    0.0    0.0    41.5    0.0      0.8        0.0       0.8    0.0     0.0
  106     WASH            0.0    48.6     27.1        0.0       2.3    0.0    0.0   170.2    0.0      3.3        0.0       3.4    0.0     0.0
  107     WASH            0.0    47.9     26.8        0.0       2.3    0.0    0.0   168.0    0.0      3.3        0.0       3.4    0.0     0.0
  108     WASH            0.0     6.2      3.5        0.0       0.3    0.0    0.0    21.8    0.0      0.4        0.0       0.4    0.0     0.0
  109     WASH            0.0     8.3      4.6        0.0       0.4    0.0    0.0    28.9    0.0      0.6        0.0       0.6    0.0     0.0
  110     WASH            0.0    10.6      5.9        0.0       0.5    0.0    0.0    37.0    0.0      0.7        0.0       0.7    0.0     0.0
  111     WASH            0.0     9.0      5.0        0.0       0.4    0.0    0.0    31.4    0.0      0.6        0.0       0.6    0.0     0.0
  112     WASH            0.0    15.7      8.7        0.0       0.8    0.0    0.0    54.9    0.0      1.1        0.0       1.1    0.0     0.0
  113     WASH            0.0     2.3      1.3        0.0       0.1    0.0    0.0     8.2    0.0      0.2        0.0       0.2    0.0     0.0
  114     WASH            0.0     4.0      2.2        0.0       0.2    0.0    0.0    14.0    0.0      0.3        0.0       0.3    0.0     0.0
  115     WASH            0.0    16.9      9.4        0.0       0.8    0.0    0.0    59.1    0.0      1.2        0.0       1.2    0.0     0.0
  116     WASH            0.0    18.9     10.6        0.0       0.9    0.0    0.0    66.3    0.0      1.3        0.0       1.3    0.0     0.0
  117     WASH            0.0    39.8     22.2        0.0       1.9    0.0    0.0   139.4    0.0      2.7        0.0       2.8    0.0     0.0
  118     WASH            0.0    24.1     13.5        0.0       1.2    0.0    0.0    84.6    0.0      1.7        0.0       1.7    0.0     0.0
  119     WASH            0.0    24.7     13.8        0.0       1.2    0.0    0.0    86.4    0.0      1.7        0.0       1.7    0.0     0.0
  120     WASH            0.0     6.8      3.8        0.0       0.3    0.0    0.0    23.8    0.0      0.5        0.0       0.5    0.0     0.0
  121     WASH            0.0     0.3      0.2        0.0       0.0    0.0    0.0     1.1    0.0      0.0        0.0       0.0    0.0     0.0
  122     WASH            0.0    17.4      9.7        0.0       0.8    0.0    0.0    61.0    0.0      1.2        0.0       1.2    0.0     0.0
```

FIGURE 26. EXAMPLE OF CAASE5 OUTPUT TABLE 2, ALLOCATED FUELS

```
WASHINGTON COUNTY, OHIO  (PARKERSBURG-MARIETTA AQCR - NEDS 1972) TEST 1/78)      APPORTIONED FUELS, TABLE  3, PAGE  1


                   * ON SITE INCINERATION *  ***** OPEN BURNING ****  ********** GASOLINE FUEL **********  ******** DIESEL FUEL ******
SOURCE             RESID.   INDUST.  C-INST.  RESID.   INDUST.  C-INST.   LT.VEH.  LT.TRUK  HV.VEH.  OFF HIWY   HV.VEH.  OFF HIWY   R.LOCO
NUMBER  COUNTY     10E1T    10E1T    10E1T    10E1T    10E1T    10E1T    10E3GAL  10E3GAL  10E3GAL  10E3GAL   10E3GAL  10E3GAL   10E3GA

   78   WASH        2.1      0.3      0.1      0.2      0.1      0.1       73.8     14.9     12.2      9.9       8.8      2.1       0.1
   79   WASH        0.4      0.1      0.0      0.0      0.0      0.0       15.1      3.0      2.5      0.4       1.8      0.1       0.0
   80   WASH       11.9      1.7      0.4      0.9      0.9      0.3      440.5     88.6     73.0     13.7      52.7      3.0       0.2
   81   WASH       37.1      5.2      1.3      2.8      2.6      1.0     1323.5    266.3    219.3      0.4     158.4      0.1       0.1
   82   WASH        9.6      1.3      0.3      0.7      0.7      0.2      335.5     67.5     55.6      0.1      40.2      0.0       0.0
   83   WASH       15.0      2.0      0.5      1.1      1.0      0.4      516.6    103.9     85.6    203.0      61.8     43.7       0.3
   84   WASH       17.5      2.6      0.6      1.3      1.3      0.5      646.6    130.1    107.1     30.6      77.4      6.6       0.2
   85   WASH        4.2      0.6      0.2      0.3      0.3      0.1      158.0     31.8     26.2      7.8      18.9      1.7       0.1
   86   WASH        0.7      0.1      0.0      0.1      0.1      0.0       26.5      5.3      4.4      2.6       3.2      0.6       0.1
   87   WASH        0.5      0.1      0.0      0.0      0.0      0.0       18.7      3.8      3.1      1.0       2.2      0.2       0.0
   88   WASH        6.2      0.9      0.2      0.5      0.5      0.2      231.5     46.6     38.4      0.5      27.7      0.1       0.1
   89   WASH        2.9      0.4      0.1      0.2      0.2      0.1      105.7     21.3     17.5      0.8      12.7      0.2       0.1
   90   WASH        0.1      0.0      0.0      0.0      0.0      0.0        2.5      0.5      0.4      1.9       0.3      0.4       0.0
   91   WASH        0.0      0.0      0.0      0.0      0.0      0.0        1.3      0.3      0.2      0.1       0.1      0.0       0.0
   92   WASH        0.7      0.1      0.0      0.1      0.1      0.0       28.3      5.7      4.7      2.7       3.4      0.6       0.1
   93   WASH        0.2      0.0      0.0      0.0      0.0      0.0        8.4      1.7      1.4      0.8       1.0      0.2       0.0
   94   WASH        4.7      0.7      0.2      0.4      0.3      0.1      174.5     35.1     28.9      7.1      20.9      1.5       0.1
   95   WASH        3.4      0.5      0.1      0.3      0.3      0.1      131.5     26.5     21.8      7.7      15.7      1.6       0.1
   96   WASH        5.9      0.9      0.2      0.5      0.4      0.2      221.7     44.6     36.7     89.3      26.5     19.2       0.2
   97   WASH       13.6      2.1      0.5      1.0      1.1      0.4      542.4    109.1     89.9     36.5      64.9      7.9       0.2
   98   WASH        6.7      1.0      0.2      0.5      0.5      0.2      256.4     51.6     42.5      3.8      30.7      0.8       0.1
   99   WASH       18.5      2.7      0.6      1.4      1.3      0.5      673.6    135.5    111.6      0.1      80.6      0.0       0.0
  100   WASH       15.9      1.8      0.4      1.2      0.9      0.3      466.0     93.7     77.2      0.1      55.8      0.0       0.1
  101   WASH       10.2      1.5      0.4      0.8      0.7      0.3      372.0     74.8     61.6      3.0      44.5      0.6       0.1
  102   WASH       12.5      1.8      0.4      1.0      0.9      0.3      448.0     90.1     74.2     41.1      53.6      8.8       0.2
  103   WASH        8.3      1.1      0.3      0.6      0.5      0.2      270.3     54.4     44.8     23.0      32.4      4.9       0.2
  104   WASH        8.5      1.3      0.3      0.7      0.7      0.2      329.5     66.3     54.6      3.8      39.4      0.8       0.1
  105   WASH        9.1      1.2      0.3      0.7      0.6      0.2      305.8     61.5     50.7      0.3      36.6      0.1       0.1
  106   WASH       43.8      5.0      1.2      3.4      2.5      0.9     1254.5    252.4    207.9      0.1     150.2      0.0       0.1
  107   WASH       29.7      4.9      1.2      2.3      2.4      0.9     1237.8    249.0    205.1      0.1     148.2      0.0       0.1
  108   WASH        5.1      0.6      0.2      0.4      0.3      0.1      160.7     32.3     26.6      0.5      19.2      0.1       0.1
  109   WASH        5.7      0.8      0.2      0.4      0.4      0.2      213.3     42.9     35.3      5.8      25.5      1.2       0.1
  110   WASH        9.3      1.1      0.3      0.7      0.5      0.2      272.7     54.9     45.2      0.3      32.6      0.1       0.1
  111   WASH        7.4      0.9      0.2      0.6      0.5      0.2      231.7     46.6     38.4      0.3      27.7      0.1       0.1
  112   WASH       13.1      1.6      0.4      1.0      0.8      0.3      404.7     81.4     67.1      0.2      48.4      0.0       0.1
  113   WASH        1.7      0.2      0.1      0.1      0.1      0.0       60.6     12.2     10.0      1.3       7.3      0.3       0.1
  114   WASH        2.8      0.4      0.1      0.2      0.2      0.1      102.9     20.7     17.0    142.6      12.3     30.7       0.2
  115   WASH       11.6      1.7      0.4      0.9      0.9      0.3      435.3     87.6     72.1     40.9      52.1      8.8       0.2
  116   WASH       12.8      1.9      0.5      1.0      1.0      0.4      488.4     98.3     80.9     40.5      58.5      8.7       0.2
  117   WASH       28.5      4.1      1.0      2.2      2.0      0.8     1027.2    206.7    170.2     19.3     123.0      4.1       0.2
  118   WASH       17.3      2.5      0.6      1.3      1.2      0.5      623.6    125.5    103.3     31.8      74.7      6.8       0.2
  119   WASH       18.3      2.5      0.6      1.4      1.3      0.5      636.8    128.1    105.5    491.9      76.2    105.9       0.4
  120   WASH        5.6      0.7      0.2      0.4      0.3      0.1      175.7     35.3     29.1     61.1      21.0     13.2       0.2
  121   WASH        0.3      0.0      0.0      0.0      0.0      0.0        8.4      1.7      1.4      1.4       1.0      0.3       0.0
  122   WASH       13.2      1.8      0.4      1.0      0.9      0.3      449.7     90.5     74.5     30.7      53.8      6.6       0.2
```

FIGURE 27. EXAMPLE OF CAASE5 OUTPUT TABLE 3, ALLOCATED FUELS

```
WASHINGTON COUNTY, OHIO  (PARKERSBURG-MARIETTA AQCR - NEDS 1972) TEST 1/78)      APPORTIONED FUELS, TABLE  4, PAGE  1

                     ****** AIRCRAFT ******   ********** VESSELS **********   *** EVAPORATION ***   ******* MEASURED VEHICLE MILES ******
SOURCE               MILIT.  CIVIL  COMM'L,   BITUM. DE. OIL  RES.OIL   GAS    SOL.PUR.  GAS.MKTD.   LTD.ACC.  RUR.RDS.  SUB.RDS.  URB.RDS.
NUMBER   COUNTY      LC10E2  LC10E1 LC10E1    10E1T  10E4GAL 10E4GAL 10E3GAL   TONS/YR  10E5GALS    10E4MI    10E4MI    10E4MI    10E4MI

  78      WASH        0.0     3.2    0.0       0.0     6.1     0.0     0.8       1.3       1.1        0.0       0.0       0.0       0.0
  79      WASH        0.0     0.3    0.0       0.0     1.9     0.0     0.3       0.3       0.2        0.0       0.0       0.0       0.0
  80      WASH        0.0     9.1    0.0       0.0    10.4     0.0     1.4       7.7       6.7        0.0       0.0       0.0       0.0
  81      WASH        0.0     2.7    0.0       0.0     5.7     0.0     0.8      23.1      20.2        0.0       0.0       0.0       0.0
  82      WASH        0.0     0.6    0.0       0.0     2.8     0.0     0.4       5.9       5.1        0.0       0.0       0.0       0.0
  83      WASH        0.0    37.9    0.0       0.0    21.2     0.0     2.9       9.0       7.9        0.0       0.0       0.0       0.0
  84      WASH        0.0    16.5    0.0       0.0    14.0     0.0     1.9      11.3       9.9        0.0       0.0       0.0       0.0
  85      WASH        0.0     4.1    0.0       0.0     7.0     0.0     0.9       2.8       2.4        0.0       0.0       0.0       0.0
  86      WASH        0.0     1.0    0.0       0.0     3.4     0.0     0.5       0.5       0.4        0.0       0.0       0.0       0.0
  87      WASH        0.0     0.5    0.0       0.0     2.5     0.0     0.3       0.3       0.3        0.0       0.0       0.0       0.0
  88      WASH        0.0     1.3    0.0       0.0     3.9     0.0     0.5       4.0       3.5        0.0       0.0       0.0       0.0
  89      WASH        0.0     1.1    0.0       0.0     3.6     0.0     0.5       1.8       1.6        0.0       0.0       0.0       0.0
  90      WASH        0.0     0.3    0.0       0.0     1.7     0.0     0.2       0.0       0.0        0.0       0.0       0.0       0.0
  91      WASH        0.0     0.0    0.0       0.0     0.7     0.0     0.1       0.0       0.0        0.0       0.0       0.0       0.0
  92      WASH        0.0     1.0    0.0       0.0     3.5     0.0     0.5       0.5       0.4        0.0       0.0       0.0       0.0
  93      WASH        0.0     0.3    0.0       0.0     1.9     0.0     0.3       0.1       0.1        0.0       0.0       0.0       0.0
  94      WASH        0.0     4.1    0.0       0.0     7.0     0.0     0.9       3.0       2.7        0.0       0.0       0.0       0.0
  95      WASH        0.0     3.7    0.0       0.0     6.6     0.0     0.9       2.3       2.0        0.0       0.0       0.0       0.0
  96      WASH        0.0    16.5    0.0       0.0    14.0     0.0     1.9       3.9       3.4        0.0       0.0       0.0       0.0
  97      WASH        0.0    16.5    0.0       0.0    14.0     0.0     1.9       9.5       8.3        0.0       0.0       0.0       0.0
  98      WASH        0.0     3.6    0.0       0.0     6.6     0.0     0.9       4.5       3.9        0.0       0.0       0.0       0.0
  99      WASH        0.0     0.8    0.0       0.0     3.0     0.0     0.4      11.7      10.3        0.0       0.0       0.0       0.0
 100      WASH        0.0     1.0    0.0       0.0     3.4     0.0     0.5       8.1       7.1        0.0       0.0       0.0       0.0
 101      WASH        0.0     3.9    0.0       0.0     6.8     0.0     0.9       6.5       5.7        0.0       0.0       0.0       0.0
 102      WASH        0.0    15.9    0.0       0.0    13.7     0.0     1.9       7.8       6.8        0.0       0.0       0.0       0.0
 103      WASH        0.0     9.2    0.0       0.0    10.5     0.0     1.4       4.7       4.1        0.0       0.0       0.0       0.0
 104      WASH        0.0     4.1    0.0       0.0     7.0     0.0     0.9       5.7       5.0        0.0       0.0       0.0       0.0
 105      WASH        0.0     1.0    0.0       0.0     3.5     0.0     0.5       5.3       4.7        0.0       0.0       0.0       0.0
 106      WASH        0.0     1.0    0.0       0.0     3.5     0.0     0.5      21.9      19.1        0.0       0.0       0.0       0.0
 107      WASH        0.0     1.0    0.0       0.0     3.4     0.0     0.5      21.6      18.9        0.0       0.0       0.0       0.0
 108      WASH        0.0     1.0    0.0       0.0     3.5     0.0     0.5       2.8       2.4        0.0       0.0       0.0       0.0
 109      WASH        0.0     4.1    0.0       0.0     7.0     0.0     0.9       3.7       3.3        0.0       0.0       0.0       0.0
 110      WASH        0.0     1.0    0.0       0.0     3.5     0.0     0.5       4.8       4.2        0.0       0.0       0.0       0.0
 111      WASH        0.0     1.0    0.0       0.0     3.5     0.0     0.5       4.0       3.5        0.0       0.0       0.0       0.0
 112      WASH        0.0     1.0    0.0       0.0     3.5     0.0     0.5       7.1       6.2        0.0       0.0       0.0       0.0
 113      WASH        0.0     1.0    0.0       0.0     3.5     0.0     0.5       1.1       0.9        0.0       0.0       0.0       0.0
 114      WASH        0.0    14.2    0.0       0.0    13.0     0.0     1.8       1.8       1.6        0.0       0.0       0.0       0.0
 115      WASH        0.0    15.6    0.0       0.0    13.6     0.0     1.8       7.6       6.6        0.0       0.0       0.0       0.0
 116      WASH        0.0    16.5    0.0       0.0    14.0     0.0     1.9       8.5       7.4        0.0       0.0       0.0       0.0
 117      WASH        0.0    16.5    0.0       0.0    14.0     0.0     1.9      17.9      15.7        0.0       0.0       0.0       0.0
 118      WASH        0.0    16.5    0.0       0.0    14.0     0.0     1.9      10.9       9.5        0.0       0.0       0.0       0.0
 119      WASH        0.0    65.4    0.0       0.0    27.9     0.0     3.8      11.1       9.7        0.0       0.0       0.0       0.0
 120      WASH        0.0    12.1    0.0       0.0    12.0     0.0     1.6       3.1       2.7        0.0       0.0       0.0       0.0
 121      WASH        0.0     0.4    0.0       0.0     2.2     0.0     0.3       0.1       0.1        0.0       0.0       0.0       0.0
 122      WASH        0.0    13.7    0.0       0.0    12.8     0.0     1.7       7.8       6.9        0.0       0.0       0.0       0.0
```

FIGURE 28. EXAMPLE OF CAASE5 OUTPUT TABLE 4, ALLOCATED FUELS

```
WASHINGTON COUNTY, OHIO  (PARKERSBURG-MARIETTA AQCR - NEDS 1972) TEST 1/78)      APPORTIONED FUELS, TABLE  5, PAGE  1


                            DIRT            MISC.                                                            AGRICULTURAL       FROST CONTROL
                  DIRT RDS   AIR    CONSTR.  WIND      LAND     FOREST WILD FIRES   MANAGED BURNING      FIELD BURNING      ORCH.      DAYS     STRUC.
SOURCE            TRAVELED STRIPS    ACRES  EROSION   TILLING   ACR BURN    QUANT.  ACR BURN    QUANT   ACR BURN  QUANT     BURN.      FIRED    FIRES
NUMBER  COUNTY    10E3MI  LTO CYC  10E3ACR                                  T/ACR               T/ACR             T/ACR                DY/YR     #/YR

   78    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       1.0
   79    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       0.2
   80    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       5.7
   81    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0      17.1
   82    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       4.3
   83    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       6.7
   84    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       8.4
   85    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       2.0
   86    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       0.3
   87    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       0.2
   88    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       3.0
   89    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       1.4
   90    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       0.0
   91    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       0.0
   92    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       0.4
   93    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       0.1
   94    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       2.3
   95    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       1.7
   96    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       2.9
   97    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       7.0
   98    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       3.3
   99    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       8.7
  100    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       6.0
  101    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       4.8
  102    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       5.8
  103    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       3.5
  104    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       4.3
  105    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       4.0
  106    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0      16.2
  107    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0      16.0
  108    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       2.1
  109    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       2.8
  110    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       3.5
  111    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       3.0
  112    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       5.2
  113    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       0.8
  114    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       1.3
  115    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       5.6
  116    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       6.3
  117    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0      13.3
  118    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       8.1
  119    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       8.2
  120    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       2.3
  121    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       0.1
  122    WASH      0.0      0.0      0.0      0.0       0.0      0.0       0.0       0.0       0.0      0.0      0.0      0.0       0.0       5.8
```

FIGURE 29. EXAMPLE OF CAASE5 OUTPUT TABLE 5, ALLOCATED FUELS

```
WASHINGTON COUNTY, OHIO  (PARKERSBURG-MARIETTA AQCR - NEDS 1972) TEST 1/78)      APPORTIONED EMISSIONS, TABLE  1, PAGE  1

                                                                                          (PARTICULATE)
                                                                                          (TONS PER YEAR)


  SOURCE           POLIT            COORDINATES                ***************** RESIDENTIAL FUEL *****************
  NUMBER  REGION   JURIS  COUNTY   X(KM)    Y(KM)    (SQ.KM)   ANTH.    BITUM.   DIST.OIL   RES.OIL    NAT.GAS   WOOD


    78     179             WASH    421.0   4335.0     12.30     0.0      0.1       0.0        0.0        0.1      0.0
    79     179             WASH    437.0   4335.0      1.16     0.0      0.0       0.0        0.0        0.0      0.0
    80     179             WASH    437.0   4343.0     35.39     0.0      0.8       0.2        0.0        0.3      0.1
    81     179             WASH    445.0   4347.0     10.65     0.1      2.4       0.5        0.0        1.0      0.4
    82     179             WASH    449.0   4347.0      2.49     0.0      0.6       0.1        0.0        0.3      0.1
    83     179             WASH    421.0   4351.0    147.29     0.1      1.0       0.2        0.0        0.4      0.1
    84     179             WASH    437.0   4351.0     64.00     0.1      1.2       0.2        0.0        0.5      0.2
    85     179             WASH    445.0   4351.0     16.00     0.0      0.3       0.1        0.0        0.1      0.0
    86     179             WASH    449.0   4351.0      3.74     0.0      0.0       0.0        0.0        0.0      0.0
    87     179             WASH    453.0   4351.0      1.98     0.0      0.0       0.0        0.0        0.0      0.0
    88     179             WASH    461.0   4351.0      4.95     0.0      0.4       0.1        0.0        0.2      0.1
    89     179             WASH    469.0   4351.0      4.30     0.0      0.2       0.0        0.0        0.1      0.0
    90     179             WASH    485.0   4351.0      1.00     0.0      0.0       0.0        0.0        0.0      0.0
    91     179             WASH    451.0   4352.0      0.18     0.0      0.0       0.0        0.0        0.0      0.0
    92     179             WASH    449.0   4353.0      4.00     0.0      0.0       0.0        0.0        0.0      0.0
    93     179             WASH    451.0   4353.0      1.19     0.0      0.0       0.0        0.0        0.0      0.0
    94     179             WASH    445.0   4355.0     16.00     0.0      0.3       0.1        0.0        0.1      0.0
    95     179             WASH    449.0   4355.0     14.44     0.0      0.2       0.0        0.0        0.1      0.0
    96     179             WASH    437.0   4359.0     64.00     0.0      0.4       0.1        0.0        0.2      0.1
    97     179             WASH    445.0   4359.0     64.00     0.0      0.9       0.2        0.0        0.4      0.1
    98     179             WASH    453.0   4359.0     14.18     0.0      0.4       0.1        0.0        0.2      0.1
    99     179             WASH    457.0   4359.0      3.04     0.1      1.2       0.2        0.0        0.5      0.2
   100     179             WASH    461.0   4359.0      3.75     0.1      1.0       0.2        0.0        0.4      0.2
   101     179             WASH    465.0   4359.0     15.15     0.0      0.7       0.1        0.0        0.3      0.1
   102     179             WASH    469.0   4359.0     61.71     0.0      0.8       0.2        0.0        0.3      0.1
   103     179             WASH    477.0   4359.0     35.86     0.0      0.5       0.1        0.0        0.2      0.1
   104     179             WASH    453.0   4363.0     16.00     0.0      0.6       0.1        0.0        0.2      0.1
   105     179             WASH    457.0   4363.0      4.00     0.0      0.6       0.1        0.0        0.2      0.1
   106     179             WASH    459.0   4363.0      3.95     0.2      2.9       0.6        0.0        1.2      0.4
   107     179             WASH    461.0   4363.0      3.88     0.1      2.0       0.4        0.0        0.8      0.3
   108     179             WASH    463.0   4363.0      4.00     0.0      0.3       0.1        0.0        0.1      0.1
   109     179             WASH    465.0   4363.0     16.00     0.0      0.4       0.1        0.0        0.2      0.1
   110     179             WASH    457.0   4365.0      4.00     0.0      0.6       0.1        0.0        0.2      0.1
   111     179             WASH    459.0   4365.0      4.00     0.0      0.5       0.1        0.0        0.2      0.1
   112     179             WASH    461.0   4365.0      4.00     0.0      0.9       0.2        0.0        0.4      0.1
   113     179             WASH    463.0   4365.0      4.00     0.0      0.1       0.0        0.0        0.0      0.0
   114     179             WASH    421.0   4367.0     55.10     0.0      0.2       0.0        0.0        0.1      0.0
   115     179             WASH    437.0   4367.0     60.69     0.0      0.8       0.1        0.0        0.3      0.1
   116     179             WASH    445.0   4367.0     64.00     0.0      0.8       0.2        0.0        0.3      0.1
   117     179             WASH    453.0   4367.0     64.00     0.1      1.9       0.4        0.0        0.8      0.3
   118     179             WASH    461.0   4367.0     64.00     0.1      1.1       0.2        0.0        0.5      0.2
   119     179             WASH    469.0   4367.0    254.55     0.1      1.2       0.2        0.0        0.5      0.2
   120     179             WASH    485.0   4367.0     47.13     0.0      0.4       0.1        0.0        0.1      0.1
   121     179             WASH    493.0   4367.0      1.53     0.0      0.0       0.0        0.0        0.0      0.0
   122     179             WASH    437.0   4375.0     53.42     0.0      0.9       0.2        0.0        0.4      0.1
```

FIGURE 30. EXAMPLE OF CAASE5 OUTPUT TABLE 1, ALLOCATED EMISSIONS, PARTICULATES

```
WASHINGTON COUNTY, OHIO  (PARKERSBURG-MARIETTA AQCR - NEDS 1972) TEST 1/78)      APPORTIONED EMISSIONS, TABLE  2, PAGE  1

                                                                                      (PARTICULATE)
                                                                                      (TONS PER YEAR)

SOURCE                ****** COMMERCIAL AND INSTITUTIONAL FUEL *******  ********************** INDUSTRIAL FUEL ***********************
NUMBER  COUNTY  ANTH.  BITUM.  DIST.OIL  RES.OIL  NAT.GAS  WOOD   ANTH.  BITUM.  COKE  DIST.OIL  RES.OIL  NAT.GAS  WOOD  PROC.GAS

  78     WASH    0.0    1.5      0.1       0.0      0.0     0.0    0.0    12.0   0.0     0.0       0.0      0.0     0.0    0.0
  79     WASH    0.0    0.3      0.0       0.0      0.0     0.0    0.0     2.5   0.0     0.0       0.0      0.0     0.0    0.0
  80     WASH    0.0    9.1      0.7       0.0      0.0     0.0    0.0    71.5   0.0     0.1       0.0      0.1     0.0    0.0
  81     WASH    0.0   27.3      2.1       0.0      0.1     0.0    0.0   214.8   0.0     0.3       0.0      0.2     0.0    0.0
  82     WASH    0.0    6.9      0.5       0.0      0.0     0.0    0.0    54.4   0.0     0.1       0.0      0.0     0.0    0.0
  83     WASH    0.0   10.7      0.8       0.0      0.0     0.0    0.0    83.8   0.0     0.1       0.0      0.1     0.0    0.0
  84     WASH    0.0   13.4      1.0       0.0      0.1     0.0    0.0   104.9   0.0     0.1       0.0      0.1     0.0    0.0
  85     WASH    0.0    3.3      0.3       0.0      0.0     0.0    0.0    25.6   0.0     0.0       0.0      0.0     0.0    0.0
  86     WASH    0.0    0.5      0.0       0.0      0.0     0.0    0.0     4.3   0.0     0.0       0.0      0.0     0.0    0.0
  87     WASH    0.0    0.4      0.0       0.0      0.0     0.0    0.0     3.0   0.0     0.0       0.0      0.0     0.0    0.0
  88     WASH    0.0    4.8      0.4       0.0      0.0     0.0    0.0    37.6   0.0     0.0       0.0      0.0     0.0    0.0
  89     WASH    0.0    2.2      0.2       0.0      0.0     0.0    0.0    17.2   0.0     0.0       0.0      0.0     0.0    0.0
  90     WASH    0.0    0.1      0.0       0.0      0.0     0.0    0.0     0.4   0.0     0.0       0.0      0.0     0.0    0.0
  91     WASH    0.0    0.0      0.0       0.0      0.0     0.0    0.0     0.2   0.0     0.0       0.0      0.0     0.0    0.0
  92     WASH    0.0    0.6      0.0       0.0      0.0     0.0    0.0     4.6   0.0     0.0       0.0      0.0     0.0    0.0
  93     WASH    0.0    0.2      0.0       0.0      0.0     0.0    0.0     1.4   0.0     0.0       0.0      0.0     0.0    0.0
  94     WASH    0.0    3.6      0.3       0.0      0.0     0.0    0.0    28.3   0.0     0.0       0.0      0.0     0.0    0.0
  95     WASH    0.0    2.7      0.2       0.0      0.0     0.0    0.0    21.3   0.0     0.0       0.0      0.0     0.0    0.0
  96     WASH    0.0    4.6      0.4       0.0      0.0     0.0    0.0    36.0   0.0     0.0       0.0      0.0     0.0    0.0
  97     WASH    0.0   11.2      0.9       0.0      0.1     0.0    0.0    88.0   0.3     0.1       0.0      0.1     0.0    0.0
  98     WASH    0.0    5.3      0.4       0.0      0.0     0.0    0.0    41.6   0.0     0.1       0.0      0.0     0.0    0.0
  99     WASH    0.0   13.9      1.1       0.0      0.1     0.0    0.0   109.3   0.0     0.1       0.0      0.1     0.0    0.0
 100     WASH    0.0    9.6      0.8       0.0      0.0     0.0    0.0    75.6   0.0     0.1       0.0      0.1     0.0    0.0
 101     WASH    0.0    7.7      0.6       0.0      0.0     0.0    0.0    60.4   0.0     0.1       0.0      0.1     0.0    0.0
 102     WASH    0.0    9.3      0.7       0.0      0.0     0.0    0.0    72.7   0.0     0.1       0.0      0.1     0.0    0.0
 103     WASH    0.0    5.6      0.4       0.0      0.0     0.0    0.0    43.9   0.0     0.1       0.0      0.0     0.0    0.0
 104     WASH    0.0    6.8      0.5       0.0      0.0     0.0    0.0    53.5   0.0     0.1       0.0      0.0     0.0    0.0
 105     WASH    0.0    6.3      0.5       0.0      0.0     0.0    0.0    49.6   0.0     0.1       0.0      0.0     0.0    0.0
 106     WASH    0.0   25.9      2.0       0.0      0.1     0.0    0.0   203.6   0.0     0.2       0.0      0.2     0.0    0.0
 107     WASH    0.0   25.6      2.0       0.0      0.1     0.0    0.0   200.9   0.0     0.2       0.0      0.2     0.0    0.0
 108     WASH    0.0    3.3      0.3       0.0      0.0     0.0    0.0    26.1   0.0     0.0       0.0      0.0     0.0    0.0
 109     WASH    0.0    4.4      0.3       0.0      0.0     0.0    0.0    34.6   0.0     0.0       0.0      0.0     0.0    0.0
 110     WASH    0.0    5.6      0.4       0.0      0.0     0.0    0.0    44.3   0.0     0.1       0.0      0.0     0.0    0.0
 111     WASH    0.0    4.8      0.4       0.0      0.0     0.0    0.0    37.6   0.0     0.0       0.0      0.0     0.0    0.0
 112     WASH    0.0    8.4      0.7       0.0      0.0     0.0    0.0    65.7   0.0     0.1       0.0      0.1     0.0    0.0
 113     WASH    0.0    1.3      0.1       0.0      0.0     0.0    0.0     9.8   0.0     0.0       0.0      0.0     0.0    0.0
 114     WASH    0.0    2.1      0.2       0.0      0.0     0.0    0.0    16.7   0.0     0.0       0.0      0.0     0.0    0.0
 115     WASH    0.0    9.0      0.7       0.0      0.0     0.0    0.0    70.6   0.0     0.1       0.0      0.1     0.0    0.0
 116     WASH    0.0   10.1      0.8       0.0      0.0     0.0    0.0    79.3   0.0     0.1       0.0      0.1     0.0    0.0
 117     WASH    0.0   21.2      1.7       0.0      0.1     0.0    0.0   166.7   0.0     0.2       0.0      0.1     0.0    0.0
 118     WASH    0.0   12.9      1.0       0.0      0.1     0.0    0.0   101.2   0.0     0.1       0.0      0.1     0.0    0.0
 119     WASH    0.0   13.2      1.0       0.0      0.1     0.0    0.0   103.4   0.0     0.1       0.0      0.1     0.0    0.0
 120     WASH    0.0    3.6      0.3       0.0      0.0     0.0    0.0    28.5   0.0     0.0       0.0      0.0     0.0    0.0
 121     WASH    0.0    0.2      0.0       0.0      0.0     0.0    0.0     1.4   0.0     0.0       0.0      0.0     0.0    0.0
 122     WASH    0.0    9.3      0.7       0.0      0.0     0.0    0.0    73.0   0.0     0.1       0.0      0.1     0.0    0.0
```

FIGURE 31. EXAMPLE OF CAASE5 OUTPUT TABLE 2, ALLOCATED EMISSIONS, PARTICULATES

```
WASHINGTON COUNTY, OHIO  (PARKERSBURG-MARIETTA AQCR - NEDS 1972) TEST 1/78)      APPORTIONED EMISSIONS, TABLE  3, PAGE  1

                                                                                          (PARTICULATE)
                                                                                          (TONS PER YEAR)


SOURCE           * ON SITE INCINERATION *  ***** OPEN BURNING ****  ********** GASOLINE FUEL **********  ******** DIESEL FUEL *****
NUMBER  COUNTY  RESID.  INDUST.  C-INST.   RESID.  INDUST.  C-INST.  LT.VEH.  LT.TRUK  HV.VEH.  OFF HIWY  HV.VEH.  OFF HIWY  R.LOCC


  78    WASH     0.3     0.1      0.0       0.1     0.1      0.0      0.0      0.0      0.0      0.1      0.0       0.4      0.0
  79    WASH     0.1     0.0      0.0       0.0     0.0      0.0      0.0      0.0      0.0      0.0      0.0       0.0      0.0
  80    WASH     1.9     0.7      0.2       0.7     0.7      0.3      0.0      0.0      0.0      0.1      0.0       0.5      0.0
  81    WASH     5.9     2.1      0.5       2.3     2.1      0.8      0.0      0.0      0.0      0.0      0.0       0.0      0.0
  82    WASH     1.5     0.5      0.1       0.6     0.5      0.2      0.0      0.0      0.0      0.0      0.0       0.0      0.0
  83    WASH     2.4     0.8      0.2       0.9     0.8      0.3      0.0      0.0      0.0      1.1      0.0       7.3      0.0
  84    WASH     2.8     1.0      0.2       1.1     1.0      0.4      0.0      0.0      0.0      0.2      0.0       1.1      0.0
  85    WASH     0.7     0.2      0.1       0.3     0.2      0.1      0.0      0.0      0.0      0.0      0.0       0.3      0.0
  86    WASH     0.1     0.0      0.0       0.0     0.0      0.0      0.0      0.0      0.0      0.0      0.0       0.1      0.0
  87    WASH     0.1     0.0      0.0       0.0     0.0      0.0      0.0      0.0      0.0      0.0      0.0       0.0      0.0
  88    WASH     1.0     0.4      0.1       0.4     0.4      0.1      0.0      0.0      0.0      0.0      0.0       0.0      0.0
  89    WASH     0.5     0.2      0.0       0.2     0.2      0.1      0.0      0.0      0.0      0.0      0.0       0.0      0.0
  90    WASH     0.0     0.0      0.0       0.0     0.0      0.0      0.0      0.0      0.0      0.0      0.0       0.1      0.0
  91    WASH     0.0     0.0      0.0       0.0     0.0      0.0      0.0      0.0      0.0      0.0      0.0       0.0      0.0
  92    WASH     0.1     0.0      0.0       0.0     0.0      0.0      0.0      0.0      0.0      0.0      0.0       0.1      0.0
  93    WASH     0.0     0.0      0.0       0.0     0.0      0.0      0.0      0.0      0.0      0.0      0.0       0.0      0.0
  94    WASH     0.8     0.3      0.1       0.3     0.3      0.1      0.0      0.0      0.0      0.0      0.0       0.3      0.0
  95    WASH     0.5     0.2      0.1       0.2     0.2      0.1      0.0      0.0      0.0      0.0      0.0       0.3      0.0
  96    WASH     0.9     0.4      0.1       0.4     0.4      0.1      0.0      0.0      0.0      0.5      0.0       3.2      0.0
  97    WASH     2.2     0.9      0.2       0.8     0.9      0.3      0.0      0.0      0.0      0.2      0.0       1.3      0.0
  98    WASH     1.1     0.4      0.1       0.4     0.4      0.2      0.0      0.0      0.0      0.0      0.0       0.1      0.0
  99    WASH     3.0     1.1      0.3       1.1     1.1      0.4      0.0      0.0      0.0      0.0      0.0       0.0      0.0
 100    WASH     2.5     0.7      0.2       1.0     0.7      0.3      0.0      0.0      0.0      0.0      0.0       0.0      0.0
 101    WASH     1.6     0.6      0.1       0.6     0.6      0.2      0.0      0.0      0.0      0.0      0.0       0.1      0.0
 102    WASH     2.0     0.7      0.2       0.8     0.7      0.3      0.0      0.0      0.0      0.2      0.0       1.5      0.0
 103    WASH     1.3     0.4      0.1       0.5     0.4      0.2      0.0      0.0      0.0      0.1      0.0       0.8      0.0
 104    WASH     1.4     0.5      0.1       0.5     0.5      0.2      0.0      0.0      0.0      0.0      0.0       0.1      0.0
 105    WASH     1.5     0.5      0.1       0.6     0.5      0.2      0.0      0.0      0.0      0.0      0.0       0.0      0.0
 106    WASH     7.0     2.0      0.5       2.7     2.0      0.7      0.0      0.0      0.0      0.0      0.0       0.0      0.0
 107    WASH     4.8     2.0      0.5       1.8     2.0      0.7      0.0    - 0.0      0.0      0.0      0.0       0.0      0.0
 108    WASH     0.8     0.3      0.1       0.3     0.3      0.1      0.0      0.0      0.0      0.0      0.0       0.0      0.0
 109    WASH     0.9     0.3      0.1       0.3     0.3      0.1      0.0      0.0      0.0      0.0      0.0       0.2      0.0
 110    WASH     1.5     0.4      0.1       0.6     0.4      0.2      0.0      0.0      0.0      0.0      0.0       0.0      0.0
 111    WASH     1.2     0.4      0.1       0.5     0.4      0.1      0.0      0.0      0.0      0.0      0.0       0.0      0.0
 112    WASH     2.1     0.6      0.2       0.8     0.6      0.2      0.0      0.0      0.0      0.0      0.0       0.0      0.0
 113    WASH     0.3     0.1      0.0       0.1     0.1      0.0      0.0      0.0      0.0      0.0      0.0       0.0      0.0
 114    WASH     0.5     0.2      0.0       0.2     0.2      0.1      0.0      0.0      0.0      0.8      0.0       5.1      0.0
 115    WASH     1.9     0.7      0.2       0.7     0.7      0.3      0.0      0.0      0.0      0.2      0.0       1.5      0.0
 116    WASH     2.0     0.8      0.2       0.8     0.8      0.3      0.0      0.0      0.0      0.2      0.0       1.5      0.0
 117    WASH     4.6     1.6      0.4       1.7     1.6      0.6      0.0      0.0      0.0      0.1      0.0       0.7      0.0
 118    WASH     2.8     1.0      0.2       1.1     1.0      0.4      0.0      0.0      0.0      0.2      0.0       1.1      0.0
 119    WASH     2.9     1.0      0.2       1.1     1.0      0.4      0.0      0.0      0.0      2.6      0.0      17.6      0.1
 120    WASH     0.9     0.3      0.1       0.3     0.3      0.1      0.0      0.0      0.0      0.3      0.0       2.2      0.0
 121    WASH     0.1     0.0      0.0       0.0     0.0      0.0      0.0      0.0      0.0      0.0      0.0       0.0      0.0
 122    WASH     2.1     0.7      0.2       0.8     0.7      0.3      0.0      0.0      0.0      0.2      0.0       1.1      0.0
```

FIGURE 32. EXAMPLE OF CAASE5 OUTPUT TABLE 3, ALLOCATED EMISSIONS, PARTICULATES

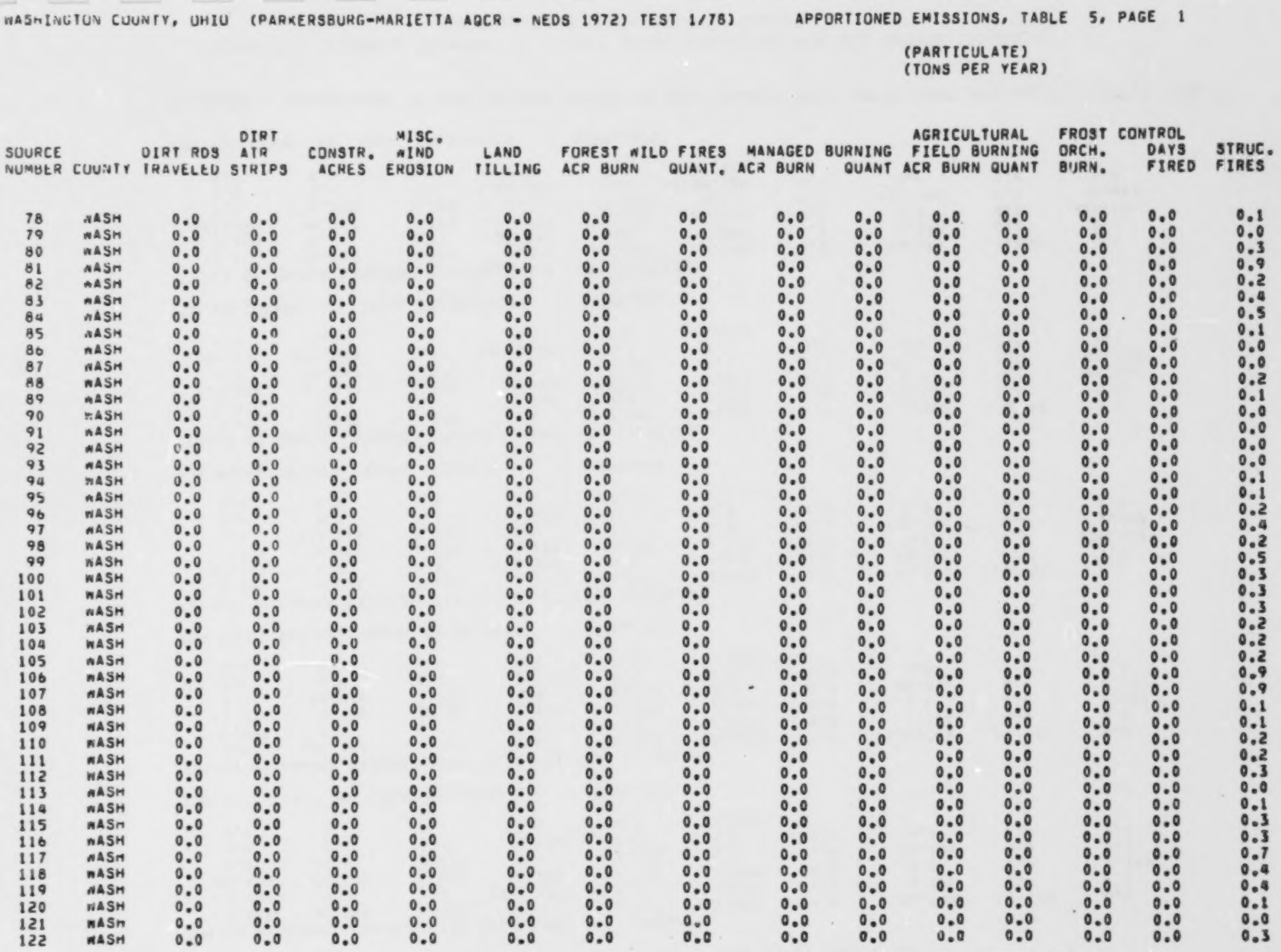
```
WASHINGTON COUNTY, OHIO  (PARKERSBURG-MARIETTA AQCR - NEDS 1972) TEST 1/78)      APPORTIONED EMISSIONS, TABLE  4, PAGE  1

                                                                                        (PARTICULATE)
                                                                                        (TONS PER YEAR)

SOURCE               ****** AIRCRAFT ******   ********** VESSELS **********   *** EVAPORATION ***   ******* MEASURED VEHICLE MILES ******
NUMBER   COUNTY   MILIT.   CIVIL   COMM'L.   BITUM. DE. OIL  RES.OIL  GAS    SOL.PUR.  GAS.MKTD.   LTD.ACC.  RUR.RDS.  SUB.RDS.  URB.RDS.

  78     WASH      0.0      0.0     0.0       0.0    0.7      0.0     0.0      0.0        0.0        0.0       0.8       0.0       0.0
  79     WASH      0.0      0.0     0.0       0.0    0.2      0.0     0.0      0.0        0.0        0.0       0.0       0.0       0.0
  80     WASH      0.0      0.0     0.0       0.0    1.2      0.0     0.0      0.0        0.0        0.0       1.1       0.0       0.0
  81     WASH      0.0      0.0     0.0       0.0    0.7      0.0     0.0      0.0        0.0        0.0       0.0       0.0       0.0
  82     WASH      0.0      0.0     0.0       0.0    0.3      0.0     0.0      0.0        0.0        0.0       0.0       0.0       0.0
  83     WASH      0.0      0.1     0.0       0.0    2.5      0.0     0.0      0.0        0.0        0.0      15.5       0.0       0.0
  84     WASH      0.0      0.0     0.0       0.0    1.7      0.0     0.0      0.0        0.0        0.0       2.3       0.0       0.0
  85     WASH      0.0      0.0     0.0       0.0    0.8      0.0     0.0      0.0        0.0        0.0       0.6       0.0       0.0
  86     WASH      0.0      0.0     0.0       0.0    0.4      0.0     0.0      0.0        0.0        0.0       0.2       0.0       0.0
  87     WASH      0.0      0.0     0.0       0.0    0.3      0.0     0.0      0.0        0.0        0.0       0.1       0.0       0.0
  88     WASH      0.0      0.0     0.0       0.0    0.5      0.0     0.0      0.0        0.0        0.0       0.0       0.0       0.0
  89     WASH      0.0      0.0     0.0       0.0    0.4      0.0     0.0      0.0        0.0        0.0       0.1       0.0       0.0
  90     WASH      0.0      0.0     0.0       0.0    0.2      0.0     0.0      0.0        0.0        0.0       0.1       0.0       0.0
  91     WASH      0.0      0.0     0.0       0.0    0.1      0.0     0.0      0.0        0.0        0.0       0.0       0.0       0.0
  92     WASH      0.0      0.0     0.0       0.0    0.4      0.0     0.0      0.0        0.0        0.0       0.2       0.0       0.0
  93     WASH      0.0      0.0     0.0       0.0    0.2      0.0     0.0      0.0        0.0        0.0       0.1       0.0       0.0
  94     WASH      0.0      0.0     0.0       0.0    0.8      0.0     0.0      0.0        0.0        0.0       0.5       0.0       0.0
  95     WASH      0.0      0.0     0.0       0.0    0.8      0.0     0.0      0.0        0.0        0.0       0.6       0.0       0.0
  96     WASH      0.0      0.0     0.0       0.0    1.7      0.0     0.0      0.0        0.0        0.0       6.8       0.0       0.0
  97     WASH      0.0      0.0     0.0       0.0    1.7      0.0     0.0      0.0        0.0        0.0       2.8       0.0       0.0
  98     WASH      0.0      0.0     0.0       0.0    0.8      0.0     0.0      0.0        0.0        0.0       0.3       0.0       0.0
  99     WASH      0.0      0.0     0.0       0.0    0.4      0.0     0.0      0.0        0.0        0.0       0.0       0.0       0.0
 100     WASH      0.0      0.0     0.0       0.0    0.4      0.0     0.0      0.0        0.0        0.0       0.0       0.0       0.0
 101     WASH      0.0      0.0     0.0       0.0    0.8      0.0     0.0      0.0        0.0        0.0       0.2       0.0       0.0
 102     WASH      0.0      0.0     0.0       0.0    1.6      0.0     0.0      0.0        0.0        0.0       3.1       0.0       0.0
 103     WASH      0.0      0.0     0.0       0.0    1.3      0.0     0.0      0.0        0.0        0.0       1.8       0.0       0.0
 104     WASH      0.0      0.0     0.0       0.0    0.8      0.0     0.0      0.0        0.0        0.0       0.3       0.0       0.0
 105     WASH      0.0      0.0     0.0       0.0    0.4      0.0     0.0      0.0        0.0        0.0       0.0       0.0       0.0
 106     WASH      0.0      0.0     0.0       0.0    0.4      0.0     0.0      0.0        0.0        0.0       0.0       0.0       0.0
 107     WASH      0.0      0.0     0.0       0.0    0.4      0.0     0.0      0.0        0.0        0.0       0.0       0.0       0.0
 108     WASH      0.0      0.0     0.0       0.0    0.4      0.0     0.0      0.0        0.0        0.0       0.0       0.0       0.0
 109     WASH      0.0      0.0     0.0       0.0    0.8      0.0     0.0      0.0        0.0        0.0       0.4       0.0       0.0
 110     WASH      0.0      0.0     0.0       0.0    0.4      0.0     0.0      0.0        0.0        0.0       0.0       0.0       0.0
 111     WASH      0.0      0.0     0.0       0.0    0.4      0.0     0.0      0.0        0.0        0.0       0.0       0.0       0.0
 112     WASH      0.0      0.0     0.0       0.0    0.4      0.0     0.0      0.0        0.0        0.0       0.0       0.0       0.0
 113     WASH      0.0      0.0     0.0       0.0    0.4      0.0     0.0      0.0        0.0        0.0       0.0       0.0       0.0
 114     WASH      0.0      0.0     0.0       0.0    1.6      0.0     0.0      0.0        0.0        0.0       0.1       0.0       0.0
 115     WASH      0.0      0.0     0.0       0.0    1.6      0.0     0.0      0.0        0.0        0.0      10.9       0.0       0.0
 116     WASH      0.0      0.0     0.0       0.0    1.7      0.0     0.0      0.0        0.0        0.0       3.1       0.0       0.0
 117     WASH      0.0      0.0     0.0       0.0    1.7      0.0     0.0      0.0        0.0        0.0       3.1       0.0       0.0
 118     WASH      0.0      0.0     0.0       0.0    1.7      0.0     0.0      0.0        0.0        0.0       1.5       0.0       0.0
 119     WASH      0.0      0.2     0.0       0.0    3.3      0.0     0.0      0.0        0.0        0.0       2.4       0.0       0.0
 120     WASH      0.0      0.0     0.0       0.0    1.4      0.0     0.0      0.0        0.0        0.0      37.6       0.0       0.0
 121     WASH      0.0      0.0     0.0       0.0    0.3      0.0     0.0      0.0        0.0        0.0       4.7       0.0       0.0
 122     WASH      0.0      0.0     0.0       0.0    1.5      0.0     0.0      0.0        0.0        0.0       2.3       0.0       0.0
```

FIGURE 33. EXAMPLE OF CAASE5 OUTPUT TABLE 4, ALLOCATED EMISSIONS, PARTICULATES



```
WASHINGTON COUNTY, OHIO  (PARKERSBURG-MARIETTA AQCR - NEDS 1972) TEST 1/78)      APPORTIONED EMISSIONS, TABLE  5, PAGE  1

                                                                                              (PARTICULATE)
                                                                                              (TONS PER YEAR)


                            DIRT             MISC.                                                              AGRICULTURAL   FROST CONTROL
SOURCE          DIRT RDS    AIR    CONSTR.   WIND      LAND    FOREST WILD FIRES   MANAGED BURNING   FIELD BURNING  ORCH.     DAYS   STRUC.
NUMBER COUNTY   TRAVELED  STRIPS    ACRES   EROSION  TILLING  ACR BURN   QUANT.   ACR BURN   QUANT  ACR BURN QUANT  BURN.    FIRED   FIRES


   78   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.1
   79   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.0
   80   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.3
   81   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.9
   82   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.2
   83   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.4
   84   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.5
   85   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.1
   86   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.0
   87   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.0
   88   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.2
   89   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.1
   90   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.0
   91   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.0
   92   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.0
   93   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.0
   94   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.1
   95   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.1
   96   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.2
   97   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.4
   98   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.2
   99   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.5
  100   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.3
  101   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.3
  102   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.3
  103   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.2
  104   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.2
  105   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.2
  106   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.9
  107   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.9
  108   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.1
  109   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.1
  110   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.2
  111   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.2
  112   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.3
  113   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.0
  114   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.1
  115   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.3
  116   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.3
  117   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.7
  118   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.4
  119   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.4
  120   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.1
  121   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.0
  122   WASH      0.0      0.0      0.0      0.0       0.0      0.0        0.0       0.0      0.0     0.0     0.0     0.0      0.0      0.3
```

FIGURE 34. EXAMPLE OF CAASE5 OUTPUT TABLE 5, ALLOCATED EMISSIONS, PARTICULATES

```
WASHINGTON COUNTY, OHIO  (PARKERSBURG-MARIETTA AQCR - NEDS 1972) TEST 1/78)

TOTALS BY SOURCE CATEGORY FOR POLLUTANT  SP  (TONS/YR)
       1.800      33.500       6.400         0.0      13.700       5.000         0.0     366.049      28.725         0.0
       1.650         0.0         0.0    2875.183         0.0       3.525         0.0       2.400         0.0         0.0
      81.440      28.000       6.800      31.200      28.000      10.400         0.0         0.0         0.0       9.346
         0.0      62.604       0.875         0.0       1.229         0.0         0.0      53.160         0.0         0.0
         0.0         0.0         0.0     133.494         0.0         0.0         0.0         0.0         0.0         0.0
         0.0         0.0         0.0         0.0         0.0      12.366

FOR POLLUTANT  SP  TOTAL EMISSIONS=       3796.844

TOTALS BY SOURCE CATEGORY FOR POLLUTANT SO2  (TONS/YR)
         0.0     280.060       9.216         0.0       0.822       0.300         0.0     573.496      27.576         0.0
       0.099         0.0         0.0    2009.743         0.0       3.572         0.0       0.144         0.0         0.0
       1.272       8.750       2.125       1.950       1.750       0.650         0.0         0.0         0.0       4.892
         0.0      56.024       1.995         0.0       0.244         0.0         0.0      66.450         0.0       0.189
         0.0         0.0         0.0      51.097         0.0         0.0         0.0         0.0         0.0         0.0
         0.0         0.0         0.0         0.0         0.0       0.023

FOR POLLUTANT SO2  TOTAL EMISSIONS=       3102.436

TOTALS BY SOURCE CATEGORY FOR POLLUTANT NOX  (TONS/YR)
       0.540       5.025       7.680         0.0     109.600       2.000         0.0      31.556     114.900         0.0
      19.800         0.0         0.0     180.300         0.0      14.100         0.0      43.200         0.0         0.0
       2.545      10.500       2.550      11.700      10.500       3.900         0.0         0.0         0.0     106.567
         0.0     693.720      12.950         0.0       1.110         0.0         0.0     496.160         0.0       0.822
         0.0         0.0         0.0    1317.095         0.0         0.0         0.0         0.0         0.0         0.0
         0.0         0.0         0.0         0.0         0.0       1.076

FOR POLLUTANT NOX  TOTAL EMISSIONS=       3199.894

TOTALS BY SOURCE CATEGORY FOR POLLUTANT  HC  (TONS/YR)
       0.450      33.500       1.920         0.0      10.960       4.000         0.0       6.860       5.745         0.0
       1.320         0.0         0.0      12.020         0.0       0.705         0.0       0.720         0.0         0.0
     229.050      17.500       4.250      58.500      52.500      19.500         0.0         0.0         0.0     300.484
         0.0      75.952       3.290         0.0       5.443         0.0         0.0     130.242         0.0      27.930
     309.000     297.000         0.0    1457.260         0.0         0.0         0.0         0.0         0.0         0.0
         0.0         0.0         0.0         0.0         0.0       3.206

FOR POLLUTANT  HC  TOTAL EMISSIONS=       3069.306

TOTALS BY SOURCE CATEGORY FOR POLLUTANT  CO  (TONS/YR)
      16.200     150.750       3.200         0.0      27.400       4.000         0.0      24.696       7.660         0.0
       3.300         0.0         0.0      24.040         0.0       0.940         0.0       4.080         0.0         0.0
     687.150      40.250       9.775     165.750     148.750      55.250         0.0         0.0         0.0    3406.650
         0.0     195.520       4.550         0.0      31.104         0.0         0.0     173.656         0.0      88.800
         0.0         0.0         0.0    7935.555         0.0   10759.125         0.0         0.0         0.0         0.0
         0.0         0.0         0.0         0.0         0.0      27.938

FOR POLLUTANT  CO  TOTAL EMISSIONS=      23996.070
```

FOOTNOTE: CATEGORIES BY ROW IN SAME ORDER AS AREA SOURCE NEDS INPUT FORM AND CAASE5 OUTPUT TABLES

FIGURE 35. EXAMPLE PRINTOUT OF COUNTY TOTAL EMISSIONS FOR ALL SOURCE CATEGORY AND POLLUTANT COMBINATIONS, CAASE5

```
WASHINGTON COUNTY, OHIO  (PARKERSBURG-MARIETTA AQCR - NEDS 1972) TEST 1/78)        IPP INPUT CARD IMAGES

1799999  780421043350 123     33  0.038  0.046  0.059  0.047  0.329    39 7100  A
1799999  790437043350  12     33  0.008  0.009  0.009  0.006  0.039    39 7100  A
1799999  800437043430 354     33  0.205  0.248  0.117  0.122  1.092    39 7100  A
1799999  810445043470 106     33  0.599  0.725  0.136  0.224  2.501    39 7100  A
1799999  820449043470  25     33  0.153  0.184  0.039  0.058  0.637    39 7100  A
1799999  8304210435101473     33  0.278  0.355  0.787  0.692  4.689    39 7100  A
1799999  840437043510 640     33  0.302  0.367  0.202  0.208  1.791    39 7100  A
1799999  850445043510 160     33  0.075  0.091  0.062  0.055  0.449    39 7100  A
1799999  860449043510  37     33  0.014  0.016  0.021  0.015  0.102    39 7100  A
1799999  870453043510  20     33  0.010  0.011  0.013  0.008  0.057    39 7100  A
1799999  880461043510  49     33  0.106  0.126  0.034  0.043  0.449    39 7100  A
1799999  890469043510  43     33  0.049  0.059  0.023  0.023  0.219    39 7100  A
1799999  900485043510  10     33  0.002  0.003  0.012  0.008  0.042    39 7100  A
1799999  910451043520   2     33  0.001  0.001  0.003  0.001  0.006    39 7100  A
1799999  920449043530  40     33  0.015  0.017  0.023  0.016  0.108    39 7100  A
1799999  930451043530  12     33  0.005  0.005  0.009  0.006  0.034    39 7100  A
1799999  940445043550 160     33  0.083  0.100  0.061  0.056  0.467    39 7100  A
1799999  950449043550 144     33  0.063  0.076  0.058  0.050  0.396    39 7100  A
1799999  960437043590 640     33  0.121  0.154  0.360  0.307  2.057    39 7100  A
1799999  970445043590 640     33  0.254  0.311  0.212  0.206  1.696    39 7100  A
1799999  980453043590 142     33  0.118  0.143  0.056  0.059  0.558    39 7100  A
1799999  990457043590  30     33  0.304  0.369  0.069  0.113  1.268    39 7100  A
1799999 1000461043590  38     33  0.216  0.258  0.054  0.085  0.899    39 7100  A
1799999 1010465043590 151     33  0.171  0.206  0.064  0.076  0.763    39 7100  A
1799999 1020469043590 617     33  0.215  0.263  0.219  0.206  1.610    39 7100  A
1799999 1030477043590 359     33  0.131  0.159  0.134  0.122  0.946    39 7100  A
1799999 1040453043630 160     33  0.151  0.183  0.063  0.071  0.694    39 7100  A
1799999 1050457043630  40     33  0.140  0.169  0.039  0.055  0.588    39 7100  A
1799999 1060459043630  39     33  0.581  0.694  0.128  0.225  2.410    39 7100  A
1799999 1070461043630  39     33  0.551  0.673  0.116  0.198  2.301    39 7100  A
1799999 1080463043630  40     33  0.075  0.090  0.027  0.032  0.320    39 7100  A
1799999 1090465043630 160     33  0.100  0.120  0.060  0.058  0.516    39 7100  A
1799999 1100457043650  40     33  0.127  0.152  0.037  0.052  0.532    39 7100  A
1799999 1110459043650  40     33  0.107  0.129  0.033  0.044  0.452    39 7100  A
1799999 1120461043650  40     33  0.187  0.224  0.049  0.074  0.779    39 7100  A
1799999 1130463043650  40     33  0.029  0.035  0.021  0.017  0.143    39 7100  A
1799999 1140421043670 551     33  0.077  0.107  0.524  0.440  2.798    39 7100  A
1799999 1150437043670 607     33  0.208  0.255  0.217  0.202  1.579    39 7100  A
1799999 1160445043670 640     33  0.232  0.284  0.221  0.210  1.671    39 7100  A
1799999 1170453043670 640     33  0.472  0.572  0.198  0.238  2.301    39 7100  A
1799999 1180461043670 640     33  0.292  0.355  0.204  0.208  1.770    39 7100  A
1799999 11904690436702545     33  0.386  0.517  1.778  1.550 10.158    39 7100  A
1799999 1200485043670 471     33  0.096  0.120  0.257  0.218  1.462    39 7100  A
1799999 1210493043670  15     33  0.005  0.006  0.012  0.008  0.044    39 7100  A
1799999 1220437043750 534     33  0.214  0.260  0.182  0.176  1.426    39 7100  A
1799999 1230445043750 640     33  0.238  0.289  0.221  0.213  1.686    39 7100  A
1799999 1240453043750 640     33  0.188  0.230  0.251  0.228  1.688    39 7100  A
1799999 1250461043750 640     33  0.139  0.173  0.317  0.275  1.884    39 7100  A
1799999 1260485043750 600     33  0.173  0.212  0.240  0.216  1.588    39 7100  A
```

FIGURE 36. EXAMPLE PRINTOUT OF DISPERSION MODEL INPUT CARD IMAGES, CAASE5, IPP MODEL

TABLE 16. OUTPUT TAPE RECORD LAYOUT FOR CAASE5[*]

OUTPUT FROM OUTPT1 SUBROUTINE (ALLOCATED FUELS)

(HEADER RECORD)

Record Position	Format	Variable Name
1	1X	CARRIAGE CONTROL (FILLER)
2 - 5	A4	IREGN
6 - 18	E13.5	STATE
19 - 28	I10	KOUNTY
29 - 38	I10	NAREAS
39 - 48	I10	IPUT
49 - 61	E13.5	TONSFW
62 - 74	E13.5	TONSMB
75 - 87	E13.5	TONSAF
88 - 100	E13.5	DAYSF

(FOR EACH GRID SQUARE (SUBSCRIPTED ON I) FOR THIS COUNTY, NAREAS IN NUMBER)

Record Position	Format	Variable Name
1 - 10	I10	ID(I)
11 - 23	E13.5	X(I)
24 - 36	E13.5	Y(I)
37 - 49	E13.5	AREA (I)
50 - 777	56E13.5	APFUEL (J,I)[+]

OUTPUT FROM OUTPT2 SUBROUTINE (ALLOCATED EMISSIONS, REPEATED FOR EACH OF THE POLLUTANTS).

(HEADER RECORD)

Record Position	Format	Variable Name
1	1X	CARRIAGE CONTROL (FILLER)
2 - 5	A4	IREGN
6 - 18	E13.5	STATE
19 - 28	I10	KOUNTY
29 - 38	I10	NAREAS
39 - 48	I10	IPUT
49 - 61	E13.5	XK
62 - 74	E13.5	DUM
75 - 87	E13.5	DUM
88 - 100	E13.5	DUM

(FOR EACH GRID SQUARE FOR THIS COUNTY, NAREAS IN NUMBER)

(SAME AS OUTPUT FROM OUTPT1 SUBROUTINE, EXCEPT THAT POSITIONS 50-777 CONTAIN ALLOCATED EMISSIONS INSTEAD OF ALLOCATED FUELS.)

---

[*] Repeated for each county being processed.

[+] Source category subscripted on J.

TABLE 16. OUTPUT TAPE RECORD LAYOUT FOR CAASE5 (CONT.)

COUNTY TOTALS OF EMISSIONS FOR THIS POLLUTANT BY SOURCE CATEGORY

Record Position	Format	Variable Name
1 - 728	56E13.5	POLTOT (J,K)*

OUTPUT FROM OUTPT3 SUBROUTINE (DISPERSION MODEL INPUT CARD IMAGES)

(FOR EACH GRID SQUARE FOR THIS COUNTY, NAREAS IN NUMBER)

Record Position	Format	Variable Name
1 - 80	+	+

---

*Source category subscripted on J; pollutant subscripted on K.

+See Area Source Input Card format in user's manuals for the IPP, CDM, and AQDM dispersion models.

TABLE 17. DEFINITIONS OF CAASE5 OUTPUT TAPE VARIABLES

Variable Name	Source	Definition
	HEADER RECORD, OUTPT1 SUBROUTINE	
IREGN		Code number of selected study area
STATE		State number (FIPS) for this county
KOUNTY		County number (EPA) for this county
NAREAS		Number of grid squares for this county
IPUT		(Type of output) Code number for source of following records where: IPUT=1 OUTPT1 =2 OUTPT2 =3 OUTPT3
TONSFW		Tons/acre burned, forest wildfires
TONSMB		Tons/acre burned, managed burning
TONSAF		Tons/acre burned, agriculture field burning
DAYSF		Frost control, orchard heaters, days/fired, days/year
	DETAIL RECORDS, OUTPT1 SUBROUTINE	
ID(I)		Grid square sequence number
X(I)		UTM Easting coordinate of the lower left hand corner of this grid square
Y(I)		UTM Northing coordinate of the lower left hand corner of this grid square
AREA(I)		Area of this grid square contained in this county
APFUEL(J,I)		Allocated fuels to this grid square-source category combination where J is source category number (fuels are in the same units as on the Area Source Input cards, see Figure 14)

TABLE 17. DEFINITIONS OF CAASE5 OUTPUT TAPE VARIABLES (CONT.)

Variable Name	Source	Definition
	HEADER RECORD*, OUTPT2 SUBROUTINE	
IREGN		As before
STATE		As before
KOUNTY		As before
NAREAS		As before
IPUT		As before
XK		Code number for which of the five pollutants follow, where: XK=1.0 (TSP) =2.0 (SO_2) =3.0 (NO_X) =4.0 (HC) =5.0 (CO)
DUM		Filler to make header records compatible
	DETAIL RECORDS, OUTPT2 SUBROUTINE	
ID(I)		As before
X(I)		As before
Y(I)		As before
AREA(I)		As before
APFUEL(J,I)		As before, except array contains allocated emissions, pollutant determined by value of XK (see above)

---

*The header record, detail records, and county total records as a set are repeated in sequence for the 5 pollutants.

TABLE 17. DEFINITIONS OF CAASE5 OUTPUT TAPE VARIABLES (CONT.)

Variable Name	Source	Definition
	ADDITIONAL RECORDS, OUTPT2 SUBROUTINE (FOLLOWING EACH OF THE 5 POLLUTANTS)	
POLTOT (J,K)		County totals of emissions for this pollutant (K) for each source category (J)
	RECORDS OUTPUT FROM OUTPT3 SUBROUTINE	
(CARD IMAGES)		See dispersion model area source card formats in IPP, AQDM, or CDM User's Manuals

emissions. The header records define which subroutine has been called, identify the detailed records that follow, and define the number of them. OUTPT3 writes dispersion model card images.

6.4 Job Control Language (JCL) and Deck Setup

An example of a deck setup configuration is illustrated in Figure 23. Using the Parkersburg-Marietta AQCR (#179) as an example study area, and Washington County, Ohio as an example county, the associated JCL and input data cards are illustrated in Figure 37. They describe the following:

A. The main program is in source language form. For illustration purposes, the set of variable dimensions has been set to 61 and the variable NDIM has been set to 60 (permitting up to 60 grid squares per county being processed). [The CAASE4 output (see Figure 17) for Washington County has a grid square count of 58; therefore, these dimensions are adequate.]

B. The CAASE5 subroutine, and the subroutines it calls, are in object deck form.

C. The allocated fuels, emissions, and dispersion model card images will be written on tape as Fortran unit number 5. It will be labeled "AQCR179.APPORT.EMISS". The volume and serial name is "KKKKKK".

D. The apportioning factor file (output from CAASE4) is on tape as Fortran unit number 6. It is labeled "AQCR179.APPORT.FACT". The volume and serial name is "JJJJJJ".

E. Dispersion model input cards will be punched on the installation dependent standard card punch device.

F. The emission factor cards, dispersion model selection card, county selector card, heading card, and NEDS Area Source fuels (throughput) cards are on the installation dependent standard card input device. IPP card images are requested. Washington County, Ohio is to be

```
//CAASE5 JOB RTI.C44.P01303,HAWS,PRTY=0,M=1,T=1,REGION=100K,PAGES=200,
// CARDS=100
// EXEC FTGCLG
//*
//*   C.SYSIN IS FOR THE CAASE5 DRIVER PROGRAM WHICH IS COMPILED FOR EACH
//*   RUN WHEN IT IS NECESSARY TO REDEFINE DIMENSIONS.
//C.SYSIN DD *
C     DRIVER FOR CAASE5 TO SET DIMENSIONS
C     MUST BE RECOMPILED ANYTIME IT IS NECESSARY TO SET DIMENSIONS
      DIMENSION APPORT(56,61),OUTIPP(61,5),ID(61),X(61),Y(61),
     1AREA(61),APFUEL(56,61)
C
C***  NDIM HAS TO BE AT LEAST AS LARGE AS THE LARGEST NUMBER OF
C     GRID SQUARES IN ANY OF THE COUNTIES BEING PROCESSED DURING
C     THIS RUN...THE ACTUAL DIMENSIONS MUST BE ONE GREATER THAN NDIM
C
      NDIM= 60
      CALL CAASE5 (APPORT,OUTIPP,APFUEL,ID,X,Y,AREA,NDIM)
      CALL EXIT
      END
/*
//L.SYSIN DD *
                              (OBJECT DECKS GO HERE)
/*
//*   UNIT 5 IS THE TAPE OUTPUT OF APPORTIONED EMISSIONS AND'FUELS.
//G.FT05F001 DD DSN=AQCR179.APPORT.EMISS,UNIT=TAPE,
//  LABEL=(1,SL),DCB=(RECFM=FB,LRECL=777,BLKSIZE=1554,DEN=3),
//  DISP=(NEW,KEEP),RING=IN,VOL=SER=KKKKKK
//*
//*   UNIT 6 IS THE TAPE INPUT OF APPORTIONING FACTORS
//*   PRODUCED BY CAASE4.
//G.FT06F001 DD DSN=AQCR179.APPORT.FACT,UNIT=TAPE,
//  LABEL=(1,SL),DCB=(RECFM=FB,LRECL=830,BLKSIZE=8300,DEN=3),
//  DISP=(OLD,KEEP),VOL=SER=JJJJJJ
//*
//*   G.SYSPUNCH IS THE UNIT RECEIVING PUNCHED CARD IMAGES
//*   FOR THE DISPERSION MODEL INPUT FORMAT SELECTED BY THE USER.
//G.SYSPUNCH DD SYSOUT=B
//G.SYSIN DD *
                    (EMISSION FACTORS GO HERE, SEE FIGURE 22)
    1
         39       167       179         58      WASH 7100   36         PKB-MAR179
   WASHINGTON COUNTY, OHIO (PARKERSBURG-MARIETTA AQCR - NEDS 1972) TEST 1/78
                           (NEDS AREA SOURCE CARDS A1-A5 FOR THIS COUNTY FOLLOW)
36710017972                           440190   184    36   335  128    0  274     4 A1
36710017972  0  686   383    0  33  0      0  2404    0   47     0    48  0   0     A2
36710017972 509    70  17   39       35   13  20178  4038  1747  2121  376     74 A3
36710017972 0   432     0  0 443      0  60   309  270     0      0      0      0 A4
36710017972    0    0    0    0      0     0  0     0  0     0  0    0  0  229 A5
                    (BLANK CARD INDICATING NO MORE COUNTIES)

   (IF MORE COUNTIES WERE TO BE PROCESSED, THEN THE REQUEST CARD, HEADER CARD,
             AND NEDS A1-A5 CARD SETS WOULD FOLLOW FOR EACH COUNTY.)
```

FIGURE 37. JCL AND INPUT CARD EXAMPLE FOR CAASE5

processed; it contains 58 grid squares. NEDS Area Source cards A1 through A5 for the Washington County, Ohio emissions inventory are to be used.

[At the installation where CAASE was developed, the cataloged procedure "FTGCLG" that will be executed (Fortran G, Compile, Link-Edit, and Go - some object decks may be included in the input) assigns Fortran I/O devices 1, 2, and 3 to the card reader, card punch, and printer, respectively.]

6.5 Warnings and Limitations

The CAASE5 main program is used to set dimensions and to pass them to the CAASE5 subroutine (which does most of the work) as "variable dimensions." The variable NDIM is related to the number of grid squares; it must be as large as the largest number of grid squares in any county currently being processed. NDIM is passed to the CAASE5 subroutine as a variable dimension; CAASE5 passes NDIM to the subroutines it calls. The value assigned to the Fortran Dimension statements in the main program must be *at least one larger* than the value assigned to NDIM. (This is necessary because whenever the CAASE5 subroutine reads the grid square file, the end of the set of grid squares for one county is signaled by reading the first record of the next county; i.e., the county ID number changes. The end-of-file condition signals the end of the set of grid squares for the last county in the file.) Setting the dimensions higher than necessary would increase computer core storage requirements and, if significantly higher, could be reflected in higher computer facility charges.

In order to estimate the number of pages of printed output to expect from a CAASE5 run, keep in mind that 30 pages of tables are printed for every set of 45 grid squares in *each* county.

The EPA/NADB algorithm for calculating emissions from highway motor vehicles (in the NEDS system) is used by CAASE5. It calculates estimated vehicle miles traveled (VMT) by vehicle class and average miles per gallon using fuels marketed data. It then distributes these VMT values to road classes (urban, rural, suburban, and limited access) proportional to the measured vehicle miles reported on the NEDS Area Source Input form. However, if measured vehicle miles are missing for all road categories (numbers 43 through 46 in Table 12), then an alternative method, even though less desirable, must be used. In this case, the estimated degree of urbanization of the county can be used; this number is recorded in column number 77 of the NEDS Area Source Input card "A3" as "Pop.Code" (population code). Because the value represents urbanization only, the algorithm does not attempt to estimate vehicle miles traveled on suburban or limited access roads. For example, an urbanization code of 3 would indicate 30% urbanization; the algorithm would assign 30% of the VMTs to the urban road class and 70% to the rural road class. If the urbanization code is also missing, the algorithm uses 90% urbanization to approximate the "worst case." Measured vehicle miles should be entered if available. If this is not possible, the user should estimate and enter a population code when it is missing.

Although all counties do not have to be processed during a computer run, those processed must be in the same order as the CAASE4 apportioning factor output file. Also, the NEDS Area Source cards must be in the same order, by counties, as the county selector cards; if the cards are out of order, an error message is printed and processing is terminated.

In some cases, a state or local agency may want to use emission factors that are different from the national ones. These present no problems because emission factors are read in by CAASE5 at program execution time. However, because CAASE5 reads emission factor data only once for a CAASE5 run, counties with local emission factors will have to be processed in separate runs if their emission factors are different from those of another county.

In the output tables, zero entries can be caused in several different ways. If no fuels were reported, or if an emission factor was not available, then obviously the output would be zero. If an overriding weighting factor was used, the user could selectively cause zeroes in some of the grid squares. If the amount allocated to a grid square is less than .05 units, rounding to the nearest .1 units for output printing would cause a zero to be printed. These small fractions are retained in the storage arrays in their original precision for any additional CAASE5 calculations.

If the percentages of ash and sulfur content are left blank on the area source input cards, their default value will be zero. Emissions from those source categories and pollutant combinations requiring ash or sulfur content will, therefore, be calculated as being zero.

7.0 SUBROUTINE DESCRIPTIONS

This section contains a description of all subroutines used in the CAASE system of programs. Flowcharts are included in the Appendixes with the appropriate CAASE calling program.

7.1 CED009 Subroutine

The CED009 subroutine is used by CAASE1 for the conversion of coordinates expressed in latitude and longitude to Universal Transverse Mercator (UTM) coordinates. The subroutine was obtained from the Mathematics and Computation Laboratory, National Resource Evaluation Center. It is described in NREC Technical Manual No. 187, dated July 1966. The subroutine will convert coordinates worldwide. CED009, as originally received, used five spheroid models which were: (1) International; (2) Clarke, 1866; (3) Clarke, 1880; (4) Everest; and (5) Bessel. Tables of coefficients necessary for the conversion equations are contained in a FORTRAN BLOCK DATA Subroutine. To minimize computer core storage requirements, the subroutine has been modified to deal only with the Clarke 1866 spheroid (the standard spheroid used in the United States for dispersion modeling). The BLOCK DATA Subroutine was modified to remove all tables of coefficients which were not related to the Clarke 1866 spheroid. The routine will convert geographic latitudes from 80° south of the Equator to 80° north of the Equator, with those south of the Equator being considered negative. The routine will convert any longitude from 180° west to 180° east of Greenwich, with those west of Greenwich being considered negative. As a result, the CAASE1 program sets the longitudes from the MED-X census data tapes to a negative value because all of the locations within the contiguous United Sates have west longitudes. Input variables to this subroutine are communicated through the subroutine call argument list except for the tables of coefficients. Those are communicated through FORTRAN labeled COMMON and are set in the BLOCK DATA Subroutine.

Preceding page blank

CED009 permits the entry of the geodetic location in radians or seconds with two different scaling factors for each. For consistency, CAASE1 calls CED009 with latitude and longitude in seconds scaled by 10^5.

An error condition indicator is returned to the calling program. CAASE1 checks the error condition and prints an error message if necessary.

7.2 GTGR Subroutine

The GTGR (grid-to-grid) subroutine converts UTM location coordinates from one UTM zone to another. It is used by CAASE1 and CAASE2 when a study area straddles a UTM zone boundary.

It is necessary in order to construct a grid made up of contiguous squares of unequal size for a common origin to be established for the entire study area. The subroutine permits the grid-to-grid conversion from east to west, or from west to east; for example, in any two neighboring zones, one can express the coordinates in the eastern zone as points relative to the western zone or, conversely, can express the points in the western zone as coordinates relative to the eastern zone.

The subroutine was developed by EPA. The mathematical formulae to convert coordinates from one UTM zone to another are those contained in the Department of the Army Technical Manual TM-5-241-8, entitled "Universal Transverse Mercator Grid" (July 1958), Chapter 5, Section 31. Tables used in the GTGR subroutine are from the Department of the Army Technical Manual TM-5-241-2. Calculations are carried out in FORTRAN DOUBLE PRECISION arithmetic, and the tables for making the conversion are in a FORTRAN DEFINE FILE statement and reside on disk. To minimize computer storage requirements, only the necessary portion of the tables are read in to central core for each point to be converted.

The FORTRAN source code for a program to create the file of GTGR tables is contained in Appendix F. A listing of the card images containing the GTGR tables is also included in Appendix F.

The CAASE system will permit either UTM zone to be declared the "primary" zone, but the user is cautioned that when selecting the eastern zone it is possible to generate negative easting (east-west) UTM coordinates. Negative coordinates are not compatible with the input requirements of the IPP, AQDM, and CDM dispersion models. For the CAASE applications thus far, the western zone has been declared the "primary" zone with few exceptions. However, since a distortion error is introduced when converting from one zone to another, and is directly proportional to the distance the point is from outside of the "primary" zone, the user should be aware that if most of a study area lies in the eastern zone, less distortion will be introduced by making the eastern zone the "primary" zone. The introduction of negative easting coordinates must still be avoided.

GTGR is used by CAASE1 for the conversion of location coordinates for census data (from the MED-X file) from one zone to another. When necessary it is used in the same manner by CAASE2 for the conversion of location coordinates describing the county outline segments.

7.3 INBOUN Subroutine

Subroutine INBOUN (used by CAASE2) reads control cards and the county boundary data. It converts the county boundary coordinates from one UTM zone to another, if required, using subroutine GTGR in the same manner as conversion of census data coordinates in CAASE1. The converted coordinates are written to I/O device NOUT1 for later processing by the program. At the user's option, INBOUN also writes the county boundary data to I/O device NOUT3. INBOUN determines the coordinates of the extreme north, south, east, and west points of the study area boundary. It initializes the list of grid squares by computing the number and locations of initial grid squares of maximum size needed to cover the entire study area.

7.4 TRACKR Subroutine

Subroutine TRACKR (used by CAASE2) determines which unit cells are interior, exterior, or boundary cells for a county. Since the techniques employed assume that the county boundary segments are oriented counterclockwise, the orientation of the segment coordinates is first tested and the segments are re-ordered if necessary.

Beginning with the first segment in the list, the points of intersection of the segments and the unit cells are computed. The unit cells intersected by the boundary are called the boundary cells. The county area contained in a boundary cell is computed. This value will be greater than zero and less than or equal to the unit cell area, in this case, 1 km^2. The distinction between interior cells and boundary cells is made on the basis of area assigned to the cell with the interior cells having the value of the unit area. In the rare event the area of a boundary cell equals unit area, its value is replaced with .999 times the unit area to permit numerical distinction.

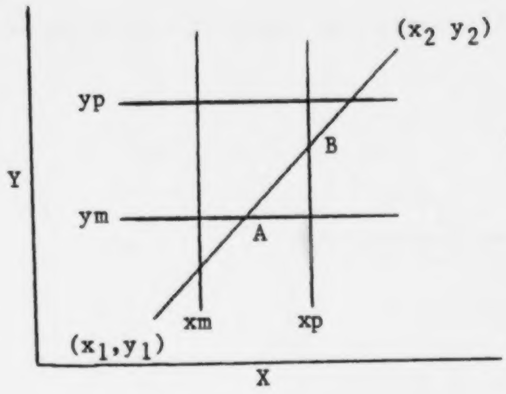
When a boundary segment departs from a unit cell, the next cell and its entry side must be found. The next cell must be one of the eight contiguous cells. As entry/departure from one boundary cell to the next occurs, the cell indices (i.e., the cell's row and column position within the grid cell array) change by ± 1 or zero. The change in indices is the key to which cells are interior to the current boundary cell. For example, if the row index changes by + 1, the next cell is upward, or north of the current cell and the unit cells on the same row and to the left of the current boundary cell are interior cells. (In counterclockwise travel, the interior region is to the left of direction of travel.)

7.5 REORDR Subroutine

REORDR is called by Subroutine TRACKR (in CAASE2) to reorder the set of county outline coordinates in counterclockwise order if necessary. This is accomplished by reversing both the order of the coordinate pairs of each segment and the order of the segments.

7.6 SIDEIT Subroutine

SIDEIT is called by subroutine TRACKR (in CAASE2) to compute the point of intersection of a given county boundary segment with a given cell. The situation is illustrated in the following figure.



The unit cell is bounded by x=xm, x=xp, y=ym and y=yp. The segment is defined by the coordinates of its end points and is directed from (x_1,y_1) to (x_2,y_2). Assuming that point A (the intersection on side y=ym) is known, the problem is to find coordinates of B, the point of intersection on x=xp. B is called the departure (or exit) node.

The general "two-point" form of the equation of a straight line,

$$\frac{y - y_1}{x - x_1} = \frac{y_2 - y_1}{x_2 - x_1},$$

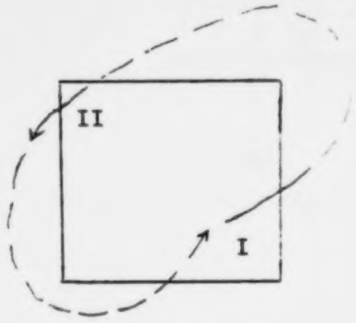
is used to find the points of intersection on the cell sides.

7.7 WRAPUP Subroutine

After a county boundary segment departs from a boundary cell, WRAPUP is called by subroutine TRACKR (in CAASE2) to finish computing the area of the interior county region. This region is enclosed by the county boundary segment and the sides of the boundary cell from the departure node to the entry node (see description of subroutine SIDEIT for definition of terms).

7.8 NETBAL Subroutine

NETBAL is called by subroutine TRACKR (in CAASE2) whenever the computed area contained in a boundary cell exceeds the unit area. The following figure shows the conditions which cause the computed contained area to exceed the unit area.



The area contained by the first transect, I, includes some area excluded by the second transect, II, namely the northwest corner of the cell. The second transect contains some area excluded by I, the southeast corner. Some of the area contained by I alone is also contained by II. The sum of the separately computed areas contained by I and II will exceed the total area of the cell by the amount of the overlapping common area. Thus, the sum of the areas must be reduced by the amount of the total area of the cell until the reduced sum is less than or equal to the total area of the cell.

Or in other words:

Contained Area = Summed Area (modulo unit area)

NETBAL performs the modulo function.

7.9 DECIDE Subroutine

DECIDE is called by subroutine TRACKR (in CAASE2) to determine the next boundary cell when a segment of the county boundary intersects the side of the current boundary cell and departs from it.

Figure 38 shows the eight combinations of Δx and Δy possible for a transect exiting side 1 of cell (i,j).

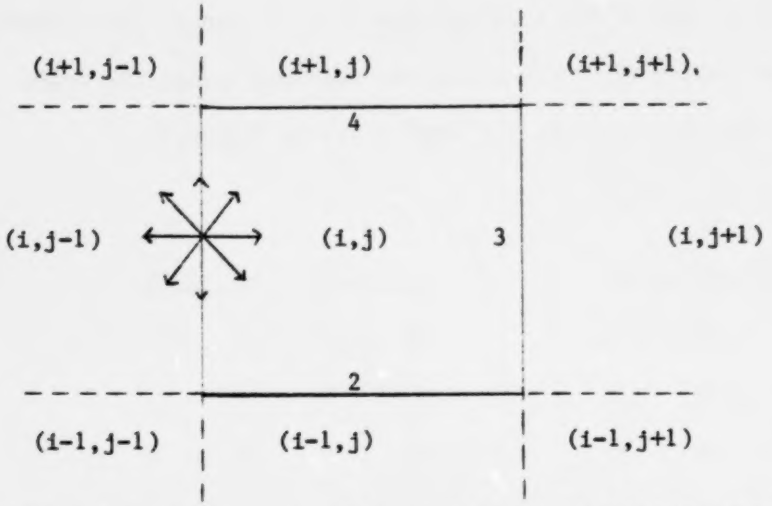


FIGURE 38. CELL (i,j), PORTIONS OF THE ADJOINING CELLS, AND THE EIGHT COMBINATIONS OF Δx, Δy FOR EXITING SIDE NUMBER 1.

These eight combinations are possible at each of the four sides and the four corners of cell (i,j). Therefore, there are 64 possible combinations of exit side and direction of departure of the county boundary from any given boundary cell. The unique outcome (that is, the next boundary cell and its entry side) for any of the 64 combinations may be described by the value of an element in two of six 3 x 3 matrices. Elements in two of the matrices are the increments that must be added to the (i,j) indices of the current cell to obtain the indices of the next cell. Elements in the other four matrices are the entry sides of the next cell. (Two of these latter four matrices are used for exits from a single side; the other two are used for exits from a corner.) The subscripts of the elements in the matrices are computed from tests on the combination of exit side and the signs of Δx and Δy of the exiting segment.

The matrices were derived by developing all 64 combinations explicitly, analyzing the results, and observing repeated patterns in the outcomes which led to groupings and simplifications. Only one example will be given to illustrate the development process.

Note in Figure 38 that the only possible increments to the indices of the current cell (i,j) are 0 for i and either 0 or -1 for j. Therefore, the two index increment tables that summarize the outcomes under the eight possible combinations of Δx and Δy for side 1 are as follows:

		Δy		
		<0	=0	>0
Δx	<0	0	0	0
	=0	0	∞	0
	>0	0	0	0

TABLE 18-a. i-INCREMENT,
EXIT SIDE 1.

		Δy		
		<0	=0	>0
Δx	<0	-1	-1	-1
	=0	0	∞	-1
	>0	0	0	0

TABLE 18-b. j-INCREMENT,
EXIT SIDE 1.

The symbol ∞ means that both Δx and Δy are not simultaneously zero.

TABLE 18-b is rewritten in matrix form as

$$\begin{pmatrix} -1 & -1 & -1 \\ 0 & \infty & -1 \\ 0 & 0 & 0 \end{pmatrix}$$

MATRIX OF j-INCREMENTS,
EXIT SIDE 1.

The row and column subscripts of the elements in the matrix are determined by the algebraic signs of Δx and Δy. For example, $\Delta x < 0$ and $\Delta y > 0$ correspond to row/column subscripts (1,3). The value of element (1,3) is -1. Thus, when the exit side is number 1, and $\Delta x < 0$, $\Delta y > 0$, the j index of the next boundary cell is j-1 where j is the value of the current boundary cell.

After complete expansion of the eight combinations of Δx and Δy applied to all four sides and all four corners, two Increment Matrices are found to be adequate:

$$\begin{pmatrix} -1 & -1 & 0 \\ -1 & \infty & 0 \\ -1 & 0 & 0 \end{pmatrix} = I_1 \qquad \begin{pmatrix} -1 & -1 & -1 \\ 0 & \infty & -1 \\ 0 & 0 & 0 \end{pmatrix} = I_2 ,$$

INCREMENT MATRIX 1 INCREMENT MATRIX 2

All other Increment Matrices may be expressed as functions of I_1 or I_2 or the zero matrix. Thus, for exit side 3 the j-increment matrix is

$$(j\text{-}inc_3) = \begin{pmatrix} 0 & 0 & 0 \\ 1 & \infty & 0 \\ 1 & 1 & 1 \end{pmatrix}$$

or

$$(j\text{-}inc_3) = I_2 + 1$$

where 1 is a 3 x 3 matrix of 1's,

The i-increment matrix for side 3 is

$$(i\text{-}inc_3) = 0.$$

The entry side table associated with an exit from side 1 is:

		Δy		
		<0	=0	>0
	<0	3	3	3
Δx	=0	1	∞	3
	>0	1	1	1

TABLE 19. ENTRY SIDE OF CELL; EXIT SIDE 1.

The entries in Table 19 were deduced from Figure 38. For example, in exiting side 1 with $\Delta x < 0$ and $\Delta y > 0$, the entry into the next cell is through side number 3. If $\Delta x > 0$ and $\Delta y < 0$, the entry side is number 1.

Complete expansion and analysis of all 64 combinations result in four Entry Side Matrices. For single-side exit, i.e., not exiting via a corner, the following two Entry Side Matrices are sufficient:

$$E_3 = \begin{pmatrix} 3 & 3 & 3 \\ 1 & \infty & 3 \\ 1 & 1 & 1 \end{pmatrix} \qquad E_4 = \begin{pmatrix} 4 & 4 & 2 \\ 4 & \infty & 2 \\ 4 & 2 & 2 \end{pmatrix}$$

The elements in E_3 are the entry sides when the exit side is 1 or 3. The elements in E_4 are the entry sides when the exit side is 2 or 4.

For corner exits, the Entry Side Matrices are:

$$E_1 = \begin{pmatrix} 4 & 4 & 2 \\ 1 & \infty & 2 \\ 1 & 1 & 1 \end{pmatrix} \qquad E_2 = \begin{pmatrix} 3 & 3 & 3 \\ 4 & \infty & 3 \\ 4 & 2 & 2 \end{pmatrix}$$

The elements in E_1 are the entry sides when the exit is through the corners formed by sides 1 and 2 or sides 1 and 4. The elements in E_2 are the entry sides when the exit is through the corners formed by sides 2 and 3 or sides 3 and 4.

The use of the Index Increment and Entry Side Matrices is summarized as follows: determination of the next cell in tracking involves selection of a cell index increment matrix and an entry side matrix according to the side, or sides, of exit from the current cell. Determination of the appropriate element in the matrices selected depends on the algebraic signs of Δx and Δy. Table 20 summarizes the use of the Index Increment and Entry Side Matrices:

Single Exit Side				Corner Exit			
	Use:				Use:		
Exit Through Side No.	i-inc matrix	j-inc matrix	entry side matrix	Exit Through Side	i-inc matrix	j-inc matrix	entry side matrix
1	0	I_2	E_3	1 & 2	I_1	I_2	E_1
2	I_1	0	E_4	2 & 3	I_1	I_{2+1}	E_2
3	0	I_{2+1}	E_3	3 & 4	I_{1+1}	I_{2+1}	E_2
4	I_{1+1}	0	E_4	4 & 1	I_{1+1}	I_2	E_1

TABLE 20. SUMMARY OF CELL INDEX INCREMENT MATRICES AND ENTRY SIDE MATRICES TO BE USED UNDER CONDITIONS OF SINGLE SIDE EXIT OR CORNER EXIT FOR SPECIFIED SIDES OR CORNERS.

7.10 NTRIOR and FINAL Subroutines

NTRIOR and FINAL are called by subroutine TRACKR (in CAASE2) to determine the cells interior to the county boundary.

The determination of the interior and exterior cells comprises two phases. The first is the flagging, on a cell-by-cell basis as tracking proceeds, of interior/exterior cells on the same row and column of the current boundary cell. This phase will "catch" the exterior cells that occur as interior pockets contained by highly convoluted figures. The second phase, applied after the figure defined by the boundary is established, will determine those cells generally exterior to the envelope (of cells) of the figure. Subroutine NTRIOR accomplishes the first phase. Subroutine FINAL accomplishes the second phase.

FINAL returns the entire grid cell array flagged with values to indicate interior, exterior, or boundary cells. These values will be used in PROXPR to print the county map and in PROXML to construct the proximal map.

7.11 PROXPR Subroutine

PROXPR is used by CAASE2. It prints a map of a county showing exterior cells as blank characters, boundary cells as asterisks, and interior cells as the character I. (See Figure 8 in Section 3.3.)

7.12 INPOP Subroutine

INPOP (used by CAASE2) reads the edited MED-X census data tape created by CAASE1, computes the total county population and housing, and determines the indices of the control cells from the Census Enumeration District (ED) coordinates.

7.13 PROXML Subroutine

Subroutine PROXML (used by CAASE2) computes the proximal map of a county based on the edited MED-X census data tape. A proximal map is based on the so-called "nearest neighbor" method of interpolation. A control cell is a unit grid cell that contains centroid coordinates of one or more Census Enumeration Districts (ED's). An empty grid cell contains no ED centroids. For each empty cell, there is a control cell nearer to it than any other control cell with the occurrence of ties (equally distant control cells) being resolved by a random selection. This nearest control cell is the nearest neighbor of the empty cell. Conversely, associated with each control cell, there is a collection of empty grid cells having it as their nearest neighbor. For any control cell, the associated collection of empty grid cells represents an approximation of the region of the ED's whose centroids are in that control cell. The sum of the cell areas is taken as the approximate area of the original ED's. Population and housing densities are computed from this approximate area and the control cell's population and housing. These densities are assumed to be uniformly distributed over the approximating area and are therefore assigned equally to each associated unit cell. Consequently, every grid cell in the county is assigned a population/housing count based on the population and housing of the ED's nearest it.

PROXML determines the nearest neighbors and computes the population and housing densities.

7.14 SEARCH and SETLGO Subroutines

SEARCH is called by subroutine PROXML (in CAASE2) to find the nearest neighbor control cell (see subroutine PROXML description) of each grid cell in a county. It employs a search technique that is based on the assumption that the most likely nearest neighbor control cell of the cell having row/column indices (i,j) is the nearest neighbor of the previous cell with indices (i, j-1). The distance from cell (i,j) to the nearest neighbor of cell (i,j-1) is used to place upper and lower limits on the indices of the rows and columns searched for a nearer neighbor to cell (i,j). Subroutine SETLGO is used in conjunction with SEARCH to determine the index of the non-empty row nearest each row of grid cells.

7.15 TIEBRK Subroutine

TIEBRK is called by subroutine SEARCH (in CAASE2) when the distances from a grid cell to two different control cells are equal. TIEBRK resolves the choice of which is nearer by calling a random number generator subroutine to provide a uniformly distributed random number between 0 and 1. If the number is greater than 0.5, the return to SEARCH will cause one of the control cells to be chosen; otherwise, the other control cell is chosen.

7.16 GRIDIT Subroutine

GRIDIT (used by CAASE2) constructs a grid square system based on a given population density surface. GRIDIT will attempt to read user-provided grid square records from the card input stream to the end of file. A count is kept on the number of cards read. If no user grid cards are provided, the count will be zero and GRIDIT will construct a grid. If cards are provided, the count will be non-zero and GRIDIT will not construct a grid.

7.17 ADJUST *Subroutine*

ADJUST (used by CAASE2) partitions boundary squares having only a small portion of their contained area within the outline of the total study area until the contained area is a greater percentage of the square's area. Any empty squares resulting from the partitioning will be deleted from the list of grid squares.

7.18 SQROFF Subroutine

SQROFF (used by CAASE2) determines which grid squares belong to which counties. If a square shares its area with a county, it is assigned that county's FIPS code number.

SQROFF reads in the population proximal map of a county and compares it to the entire list of grid squares. (The values stored in the cells making up the proximal map are population. There are two other proximal maps that contain housing and area values.) A zero value of population in a grid cell means the cell is not in the county. For a given grid square, if the sum of values of all cells within the square is zero, the grid square is totally outside the county. If the sum is not zero, the grid square and county share common area and the grid square is therefore assigned the county FIPS identification number. In addition, the summations of population, housing, and contained area in the grid cells shared by the grid square with the three proximal maps are assigned to the square.

A square may overlap more than one county. In this case, the square will receive multiple county assignments. Separate card image records of the grid square will be output for each county to which the square belongs with the records differing in the county code, fractional area contained, contained population and contained housing. The side lengths and southwest corner coordinates of squares having multiple records are equal.

7.19 OUTPUT Subroutine

OUTPUT is used by CAASE2 to output the card images and print the grid square records.

7.20 PARTIT Subroutine

PARTIT is called in CAASE2 by subroutines GRIDIT and ADJUST to partition a specified grid square into four smaller squares of equal size by dividing its side length by two. The coordinates of the southwest corners of the new squares are one-half the side lengths from the origin of the original square. The list of grid squares is updated by adding the side lengths and coordinates of the new squares to the appropriate vector storage arrays. The total number of squares is increased by three. A test of the number of squares versus the maximum* permissible governs the return to the calling program. A test to prevent partitioning of squares to less than unit area is included.

7.21 DELETE Subroutine

DELETE is called in CAASE2 by subroutines GRIDIT and ADJUST to remove empty grid squares from the list of grid squares.

7.22 INTEGR Subroutine

INTEGR is called in CAASE2 by subroutines GRIDIT, ADJUST, and SQROFF to compute the integral of either population, housing, or area in a grid square specified by the calling program.

7.23 ASTORE and NSTORE Subroutines

The purpose of subroutines ASTORE and NSTORE (used by CAASE2) is to eliminate repetitive coding of FORTRAN IF - GO TO statements followed by non-computational equations. Their functioning is apparent from their simple coding. The difference between them is that the arguments of ASTORE are floating point variables, and those of NSTORE are integers. NSTORE is an ENTRY in ASTORE. Other entries in ASTORE are subroutines YOFX and XOFY. ASTORE is called by subroutines TRACKR and WRAPUP, NSTORE by DECIDE and SIDEIT.

---

*1800 in applications thus far.

7.24 YOFX and XOFY Subroutines

YOFX AND XOFY are entries in subroutine ASTORE used by CAASE2. They are called by subroutine SIDEIT to compute the intersections of the county boundary segments with the grid cells.

The two point equation of a straight line is given by

$$\frac{y - y_1}{x - x_1} = \frac{y_2 - y_1}{x_2 - x_1}$$

For specified (x_1,y_1), (x_2,y_2), and x, YOFX computes

$$y = (x - x_1) \frac{y_2 - y_1}{x_2 - x_1} + y_1$$

For specified (x_1,y_1), (x_2,y_2), and y, XOFY computes

$$x = (y - y_1) \frac{(x_2 - x_1)}{(y_2 - y_1)} + x_1$$

Both subroutines test for denominators less than the variable, "EPS" (a very small number specified in the main program) in absolute value; this is a test for zero divisor. If such should occur, the solution is set to a large value.

7.25 FAREA Subroutine

FAREA (used by CAASE2) computes the area A under the line segment in Figure 39 by the formula:

$$A = \frac{(y_2 + y_1)}{2} (x_2 - x_1).$$

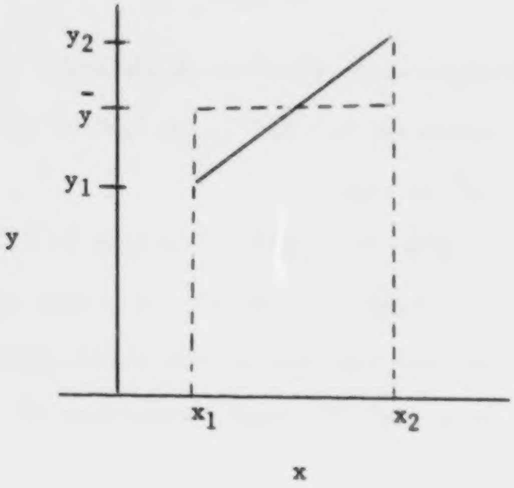


FIGURE 39. AREA UNDER A LINE SEGMENT.

7.26 SORT Subroutine

SORT is used by CAASE2 to sort the grid squares in ascending order by state, county, UTM Northing, and UTM Easting.

7.27 POPBOX Subroutine

POPBOX is used by CAASE3. It creates the plotter file for drawing a scaled map of the study area. POPBOX causes a message to be issued to the operator to mount 30-inch wide plotter paper. The axes and tick-marks are drawn and labeled.

POPBOX also draws the grid square network. It is given the coordinates of the lower left-hand corner of each grid square and its side length. It calculates the coordinates for the other three corners. Lines are then drawn through the five points (the lower-left hand corner being both the starting and ending point). A grid can be drawn to any scale, the only limitation being the physical size of the available plotter space. In the CAASE applications thus far, the scale 1:250,000 has been used. The scale factor is an input variable to the CAASE3 main program.

7.28 EDPLOT Subroutine

EDPLOT is used by CAASE3 to optionally plot the enumeration districts and psuedo-enumeration districts as processed by CAASE1. A control parameter read by CAASE3 determines whether EDPLOT is used.

As discussed in the CAASE1 program description (Section 2), there are three types of enumeration districts output by CAASE1. A unique mark from the CALCOMP plotter subroutine MARK is used for each of the three types of enumeration districts. Type 1 uses mark #1, type 2 uses mark #5, and type 3 uses mark #9.

7.29 COOUT Subroutine

COOUT is optionally used by CAASE3 to draw county outlines on the study area map. A control parameter read by CAASE3 determines whether COOUT is used.

7.30 READ1 Subroutine

READ1 is used by CAASE5 to read the fuels (throughput) totals for the county being processed. The format is the same as the first five cards on the NEDS Area Source Form [EPA (DUR) 219 3/72]. The routine also calculates the gasoline fuel use for light trucks using fractions of the reported fuels for light vehicles (gasoline) and heavy vehicles (gasoline). The algorithm currently used by the EPA National Air Data Branch (NADB) for the National Emissions Data System (NEDS) area sources is used.

The following calculations are used:

Light Truck Fuel Total = .122 x Light Vehicle Fuel Total

+ .273 x Heavy Vehicle Fuel Total.

Light vehicle and heavy vehicle fuels are reduced accordingly, that is:

Modified Light Vehicle Fuel Total = Reported Light Vehicle

Fuel Total x .878.

Modified Heavy Vehicle Fuel Total = Reported Heavy Vehicle

Fuel Total x .727.

7.31 OUTPT1 Subroutine

OUTPT1 is used by CAASE5. It formats and prints a tabular listing of the allocated county fuels (throughput) totals for all area source categories identified on the NEDS Area Source Form [EPA (DUR) 219 3/72].

OUTPT1 also writes a formatted tape (see Tables 16 and 17 for a description of the record layout and contents).

7.32 OUTPT2 Subroutine

OUTPT2 is used by CAASE5. It formats and prints the allocated emissions for each source category identified on the NEDS Area Source Form [EPA (DUR) 219 3/72].

As a county is being processed by CAASE5, OUTPT2 is called five times, once for each pollutant (TSP, SO_2, NO_x, HC, and CO).

OUTPT2 also writes a formatted tape (see Tables 16 and 17 for a description of the record layout and contents).

With the exception of formatting and labeling, OUTPT2 is very similiar to OUTPT1.

7.33 OUTPT3 Subroutine

This routine is called by the CAASE5 program and outputs allocated area source emissions as cards (or card images) for direct input to one of three atmospheric dispersion models. The three models are the Implementation Planning Program (IPP), the Air Quality Display Model (AQDM), and the Climatological Dispersion Model (CDM). The selection of the format is controlled by an input variable.

As each county is processed, one emissions total is output for each grid square for each pollutant. That is, the calculated emissions for all area source categories allocated to a grid square are summed. Units conversions are made if necessary. A constant value of 10 meters or 33 feet is assigned as the stack height.

OUTPT3 also writes a formatted tape (see Tables 16 and 17 for a description of the record layout and contents).

8.0 OBJECTIVE APPORTIONING FACTORS AND SUBJECTIVE OVERRIDING WEIGHTING FACTORS

This section discusses the procedures for introducing user-provided overriding weighting factors for allocating fuels and emissions to the sub-county grid square network. The assignment of overriding weighting factors and their effect on the objective apportioning factors are discussed in detail in this section. The program input formats and descriptions are included in the discussion of the CAASE4 program in Section 5.

A basic concept in the development of the CAASE procedures was to use objective techniques, where possible, to select a grid. Also, objective methods were to be used, when possible, for allocating fuels (throughput) and emissions from county totals for each source category into each grid square. It was recognized that many of the source categories were amenable to apportioning as functions of the distribution of population and housing within counties. Ideally, objective methods could be used throughout the processing of area source data using computer processable data sources already available in computer compatible data bases. Certain categories of usable data are available for some counties while not always available for others; further, much of the data exist only in source document or tabular form, e.g., land use maps, traffic counts, airport operations activity, etc. Much effort would be necessary to assemble and incorporate these data into a computer processable data base for objective apportioning. Such an effort, practical or not, was beyond the scope of the CAASE project. It appeared, however, that area source emissions for most categories were amenable to distribution by objective techniques to the grid squares of a county.

For convenience, the fields of fuels (throughput) data on the NEDS Area Source Input Form [EPA (DUR) 219 3/72] have been sequentially numbered. Table 12 relates the assigned category number to its major and minor classifications. (Category number 28, Gasoline Fuel, Light Truck is a derived number calculated by taking a portion of categories 27 and 29 fuels.)

The majority of the categories can be apportioned using functions of area, population, and housing. However, provisions are made in the CAASE4 program to override any or all source categories for each grid square if available information indicates that the objective factors used by CAASE4 will not yield acceptable results. To facilitate the use of any additional available data for apportioning, the apportioning factor program (CAASE4) logic has been written to optionally accept user-provided weighting factors for any area source category for any grid square. As discussed in more detail in later paragraphs, the "effective" apportioning factor is the product of the user-provided weighting factor multiplied times the assigned objective factor. The default user-provided weighting factor is 1.0.

An objective apportioning factor has been assigned to each area source emission category reported on the NEDS Area Source Form [EPA (DUR) 219 3/72]. Table 21 shows the objective apportioning factor assigned for each source category. Candidate objective apportioning factors available on the Bureau of the Census MED-X* tapes include population, housing counts, and an urban-rural classification. After the grid is established, each grid square's contained population, housing, area, and side length+ are available.

When available apportioning factors were being selected and assigned to the source categories, it was concluded that some categories were quite

---

*Master Enumeration District Listing (MEDList) extended to include geographic coordinates.

+If the contained area for a grid square is shared by two or more counties, an "effective side length" for each county is calculated by computing the square root of the contained area within that county.

TABLE 21. "NEW" AREA SOURCE EMISSIONS CATEGORY NUMBERS AND THEIR OBJECTIVE APPORTIONING FACTOR

CATEGORY NUMBER	MAJOR CLASSIFICATION	MINOR CLASSIFICATION	OBJECTIVE APPORTIONING FACTOR*
1	RESIDENTIAL FUEL	ANTH. COAL	HOUSING UNITS
2	RESIDENTIAL FUEL	BITUM. COAL	HOUSING UNITS
3	RESIDENTIAL FUEL	DIST. OIL	HOUSING UNITS
4	RESIDENTIAL FUEL	RESID. OIL	HOUSING UNITS
5	RESIDENTIAL FUEL	NAT. GAS	HOUSING UNITS
6	RESIDENTIAL FUEL	WOOD	HOUSING UNITS
7	COMM'L & INSTITL FUEL	ANTH. COAL	POPULATION
8	COMM'L & INSTITL FUEL	BITUM. COAL	POPULATION
9	COMM'L & INSTITL FUEL	DIST. OIL	POPULATION
10	COMM'L & INSTITL FUEL	RESID. OIL	POPULATION
11	COMM'L & INSTITL FUEL	NAT. GAS	POPULATION
12	COMM'L & INSTITL FUEL	WOOD	POPULATION
13	INDUSTRIAL FUEL	ANTH. COAL	POPULATION
14	INDUSTRIAL FUEL	BITUM. COAL	POPULATION
15	INDUSTRIAL FUEL	COKE	POPULATION
16	INDUSTRIAL FUEL	DIST. OIL	POPULATION
17	INDUSTRIAL FUEL	RESID. OIL	POPULATION
18	INDUSTRIAL FUEL	NAT. GAS	POPULATION
19	INDUSTRIAL FUEL	WOOD	POPULATION
20	INDUSTRIAL FUEL	PROCESS GAS	POPULATION
21	ON-SITE INCINERATION	RESIDENTIAL	HOUSING UNITS
22	ON-SITE INCINERATION	INDUSTRIAL	POPULATION
23	ON-SITE INCINERATION	COMM'L & INSTITL	POPULATION
24	OPEN BURNING	RESIDENTIAL	HOUSING UNITS
25	OPEN BURNING	INDUSTRIAL	POPULATION
26	OPEN BURNING	COMM'L & INSTITL	POPULATION
27	GASOLINE FUEL	LIGHT VEHICLE	POPULATION
28	GASOLINE FUEL	LIGHT TRUCK	POPULATION
29	GASOLINE FUEL	HEAVY VEHICLE	POPULATION
30	GASOLINE FUEL	OFF HIGHWAY	1/POPULATION DENSITY
31	DIESEL FUEL	HEAVY VEHICLE	POPULATION
32	DIESEL FUEL	OFF HIGHWAY	1/POPULATION DENSITY
33	DIESEL FUEL	RAIL LOCOMOTIVE	GRID SQ. SIDE LENGTH
34	AIRCRAFT	MILITARY	AREA
35	AIRCRAFT	CIVIL	AREA
36	AIRCRAFT	COMMERCIAL	AREA
37	VESSELS	COAL	GRID SQ. SIDE LENGTH
38	VESSELS	DIESEL OIL	GRID SQ. SIDE LENGTH
39	VESSELS	RESID. OIL	GRID SQ. SIDE LENGTH
40	VESSELS	GASOLINE	GRID SQ. SIDE LENGTH
41	EVAPORATION	SOLVENT PURCHASED	POPULATION
42	EVAPORATION	GASOLINE MARKETED	POPULATION
43	MEASURED VEH MILES	LIMITED ACCESS RDS	1/POPULATION DENSITY
44	MEASURED VEH MILES	RURAL ROADS	1/POPULATION DENSITY
45	MEASURED VEH MILES	SUBURBAN RDS	POPULATION
46	MEASURED VEH MILES	URBAN ROADS	POPULATION
47	DIRT RDS TRAVELED	...	1/POPULATION DENSITY
48	DIRT AIRSTRIPS	...	1/POPULATION DENSITY
49	CONSTRUCT LAND AREA	...	AREA
50	MISC. WIND EROSION	...	1/POPULATION DENSITY
51	LAND TILLING	...	1/POPULATION DENSITY
52	FOREST WILDFIRES	AREA-ACRES	1/POPULATION DENSITY
53	MANAGED BURNING	AREA-ACRES	1/POPULATION DENSITY
54	AGRI. FIELD BURNING	AREA-ACRES	1/POPULATION DENSITY
55	FROST CONTROL	ORCHARD HEATERS	1/POPULATION DENSITY
56	STRUCTURE FIRES	NO. PER YEAR	POPULATION

---

*Each of the above apportioning factors is multiplied by a weighting factor initialized as 1.0 for all grid squares. These initial weighting factors can be overridden with input data if desired.

amenable to apportioning using objective factors whereas others are not. For example, the housing count in each grid square is a good choice for allocating residential heating source categories. However, source categories associated with aircraft operations affect only portions of a county and should be overridden in most cases.

Although the CAASE system permits overriding weighting factors to be assigned for any source category, they should be limited to those categories where acceptable objective data (in a computer processable form) are not available. To allocate emissions from airport operations over the entire county as a function of the area of each grid square (see Table 21) might introduce only a small error. However, it can easily be determined which grid squares in a county contain airports, or are affected by the airports. On the other hand, much time could be spent in preparing overriding weighting factors for railroad operations. To allow CAASE4 to use the objective factor (i.e., grid square side length) to assign apportioning factors to all grid squares in an urban county containing a large number of grid squares and heavy railroad activity (e.g., St. Clair County, Illinois) may yield comparable results. The percentage errors may be acceptable.

One suggested approach, before deciding to override a source category, is to run the CAASE4 program without overriding the objective apportioning factors for the category; then to run the CAASE5 program with those assigned apportioning factors. Two outputs from CAASE5 are the county totals of emissions by pollutant and a table of county totals by source category and pollutant (see Figure 35 in Section 6). Each source category's contribution to the county total area source emissions can be readily determined. For example, from data in Figure 35, Washington County, Ohio railroad activity (category 33) contributed .875 tons/year of TSP to the county total of 3796.8

tons/year and therefore represents only .023% of the total. NO_x for railroad activity is .405% of the Washington County total.

An important point to keep in mind when assigning overriding weighting factors is that the calculated apportioning factors are normalized in the CAASE5 program. That is, each apportioning factor is developed by dividing the weight assigned to the particular grid square (for a particular source category) by the sum of the weights assigned to all grid squares (for that category) in the county. The total fuels or emissions apportioned to the individual grid squares in the county will not be modified whether the total refers to housing counts, area, population, or a combination of these and/or other factors. For each source category, the apportioning factors represent each grid square's proportion of the county total. This apportioning factor is the numerator for the fraction of total fuels (or emissions) which will be apportioned to that particular grid square for that particular source category. To sum all of the fractions for a particular source category associated with each individual grid square within the county will yield unity.

As discussed earlier, the effective apportioning factor is calculated by multiplying an objective apportioning factor (see Table 21) by a weighting factor. The apportioning algorithm in CAASE4 assumes a weighting factor of 1.0. If the default weighting factor of 1.0 is used, the apportioning is totally controlled by the assigned objective apportioning factor, e.g., housing units. The following paragraphs discuss how to override the default 1.0 weighting factor. When a source category is to be overridden, a card is read by CAASE4 with the source category number and an initialization constant (generally 0.0 or 1.0). Cards are then read for each grid square that is to be overridden with a different weighting factor than the initialized factor for that source category.

An example of source category weighting factors that generally should be overridden are those for airport operations (source categories 34, 35, and 36). If no airports are located within the county or if LTO (Landing-Take-Off) cycles are not included in the area source inventory, no airport weighting factor overriding action is necessary. For airport operations categories the initializing constants (read by CAASE4) should be zero because fewer grid squares will be allocated fuels and emissions than those that will not. These user-initialized zero weighting factor assignments mean that no aircraft landing-take-off cycles, or emissions associated with them, will be allocated to a grid square unless the user assigns a non-zero weighting factor to that grid square. For aircraft LTOs and associated emissions the assigned objective apportioning factor is area. A grid square which has a large area would therefore be allocated more LTOs and associated emissions than a grid square which has a smaller area (if the weighting factors are equal). If a grid square is affected by aircraft operations, the user can, for example, assign a 1.0 weighting factor. (This is done after initializing all grid squares to zero for the aircraft categories.) The CAASE4 program would then assign apportioning factors strictly as a function of area for only those grid squares affected; that is, a grid square of one square kilometer would be assigned an apportioning factor only one twenty-fifth (1/25th) of the apportioning factor assigned to a five-by-five kilometer grid square representing 25 square kilometers. The user would normally want to assign higher weights to grid squares near an airport than to those farther away. To do this the user can, for example, assign an overriding weighting factor of 3.0 to the grid squares nearest an airport, 2.0 to grid squares farther away but still affected, and 1.0 to the furthermost affected grid squares.

This would cause both the area of the affected grid squares and their proximity to the airport (and aircraft operations areas) to be determining factors in allocating LTOs and associated emissions within the county. The values 3.0, 2.0, and 1.0 were used for illustration. The user can assign any value on any scale. The procedure is more complex in a county containing more than one active airport. In this case, the user must keep in mind that the weighting factors apply to the county totals. If data are available for the relative operational activity at the two or more airports in the county, these data should be used in assigning overriding weighting factors. Referring back to the example above, where proximity to the airport was also taken into consideration, and supposing the county had two airports, then let the above example be for Airport A. Let the second airport be called Airport B. If Airports A and B had equal operational activity, i.e., LTOs for a source category, then 3.0, 2.0, and 1.0 weighting factors could be assigned to grid squares affected by Airport B LTOs according to their proximity to Airport B in the same manner as was done with Airport A. The next degree of complexity for the two-airport example is encountered when their relative activities for a source category are not equal. To modify the above two-airport example, for illustration, suppose Airport B had twice the activity as Airport A (i.e., two-thirds of the LTOs were at Airport B and one-third at Airport A); then, the nearest grid square to Airport B could be assigned an overriding weighting factor of 6.0 whereas a 3.0 had been assigned to the nearest grid square for Airport A, etc. The overriding weighting factors assigned to other affected grid squares must reflect both the relative airport activity and each affected grid square's proximity to the airports.

The above examples for aircraft activity were given to illustrate the overriding of source categories where the area of the grid square is the objective factor. Although conceptually similar, other source categories are treated differently.

Area source categories such as railway locomotives and waterborne vessels are also assigned apportioning factors as a function of the size of the grid square. However, in these cases the distance across a grid square and how the waterway or railroad tracks cross it are used in assigning an overriding weighting factor. The longest distance across a grid square is diagonally through opposite corners (e.g., northwest corner to southeast corner). This distance is directly proportional to the grid square side length. The ratio of the diagonal to the side length is a constant ($\sqrt{2}$ to 1). This constant would drop out in the CAASE5 apportioning factor normalizing calculations. The grid square side length is therefore used directly for these source categories. The discussion and examples following will be limited to the railway locomotive category, but the approach suggested is equally applicable to the waterborne vessel categories.

If the railway locomotive source category is to be assigned overriding weighting factors, then there are several things to consider when assigning an overriding factor to a grid square. To simplify the examples, no attempt is made to incorporate the number of trains passing across a grid square in a given time frame, nor is the average number of locomotive units per train considered. These data probably will seldom be directly available to the CAASE user. The number of pairs of tracks crossing the grid square is directly available from USGS (U.S. Geological Survey) maps. These maps can be used with a grid square network plotted by CAASE3 as an overlay, or where the grid squares have been drawn directly on the map. For each pair of tracks, the user can visually estimate the distance in crossing the grid square as compared to the maximum distance possible across the grid square.

Then the overriding weighting factor for a grid square is a combination of the number of tracks crossing it and the relative length of the crossing distance for each. Recall that the effective apportioning factor is the product of the weighting factor and the assigned objective apportioning factor, in this case, grid square side length. Because the overriding weighting factor that should be assigned to a grid square includes both the number of tracks and the relative length of each, it is suggested that the user establish an arbitrary scale to include both terms. For example, a scale of 0.0 to 10.0 could be used. One pair of tracks, crossing the grid square along the maximum length path, would be assigned a 1.0, two pairs of tracks along the same path a 2.0 etc. For tracks across the grid square along some path less than the maximum distance, each pair of tracks can be assigned a fraction of 1.0. On a scale of 0.0 to 10.0, the following figures are examples of the suggested procedure where ┼┼┼┼┼┼ will denote a single pair of tracks and ╫╫╫╫╫╫ will denote a double pair of tracks.

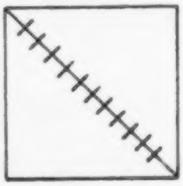


FIGURE 40-A. EXAMPLE OF RAILWAY LOCOMOTIVE WEIGHTING FACTOR OF 1.0 (2 KM X 2 KM GRID SQUARE)

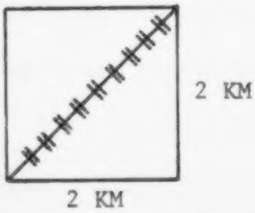


FIGURE 40-B. EXAMPLE OF RAILWAY LOCOMOTIVE WEIGHTING FACTOR OF 2.0

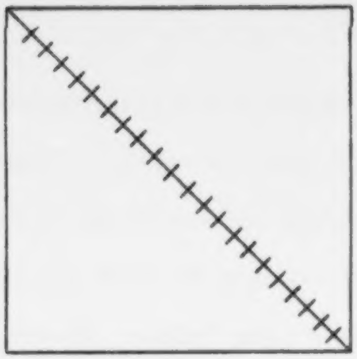


FIGURE 40-C. EXAMPLE OF RAILWAY LOCOMOTIVE WEIGHTING FACTOR OF 1.0
(4 KM X 4 KM GRID SQUARE)

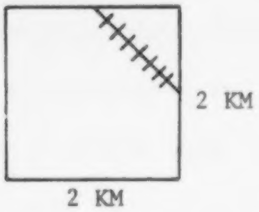


FIGURE 40-D. EXAMPLE OF RAILWAY LOCOMOTIVE WEIGHTING FACTOR OF 0.5

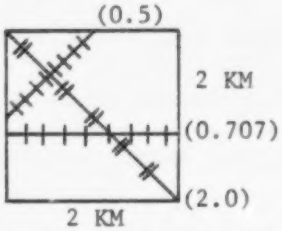


FIGURE 40-E. EXAMPLE OF RAILWAY LOCOMOTIVE WEIGHTING FACTOR OF 3.21

The examples in Figures 40-A through 40-E illustrate that the count of tracks and how they cross the grid squares make up the user-supplied overriding weighting factors input to CAASE4. The 1.0 weighting factor in Figure 40-A, (a 2 km by 2 km grid square) and Figure 40-C (a 4 km by 4 km grid square) will be multiplied by the grid square side length by the CAASE4 program. This will cause the grid square represented by Figure 40-C to receive an allocation of twice the amount of fuels and associated emissions as the grid square represented by Figure 40-A.

If the CAASE user does have relative traffic data for the track segments, it can be incorporated into the weighting factor procedure.

For those source categories using assigned population or housing counts, the user-provided overriding weighting factors are handled by CAASE4 in the same manner as the examples above. *The effective apportioning factor for each grid-square-source-category combination is the product of the user-provided overriding weighting factor (or the default value of 1.0) times the assigned objective apportioning factor.* It is fairly straightforward to use maps to locate airports, waterways and railroads. However, population and housing distribution maps are not as readily available. The CAASE user can refer to the CAASE2 output for these housing and population counts for each grid square (or portion thereof) for each county.

The CAASE4 program reads the grid file output from the CAASE2 program. This file contains the fractional area, contained housing, and contained population, for that portion of each grid square within the county, in addition to location coordinates and county identificaion. The assigned housing and population counts are included in the CAASE2 printout (see Figure 8).

Using the allocation of distillate oil used for residential fuel (and its associated emissions) as an example, the user is probably very limited in providing any overriding weighting factors. The user probably does not have enough detailed information on the distribution of residences using distillate oil (as compared to other fuels) to improve on the CAASE default method of allocating solely on total housing distribution. However, the user may, for example, be able to estimate that the percentage of residences using distillate oil and located in the grid squares in one part of the county is twice that in the remainder of the county. In this case, the CAASE user could initialize the source category (number 3 in Table 21) to 1.0. Overriding weighting factors of 2.0 could then be input for the grid squares that had twice the percentage of residences using distillate oil.

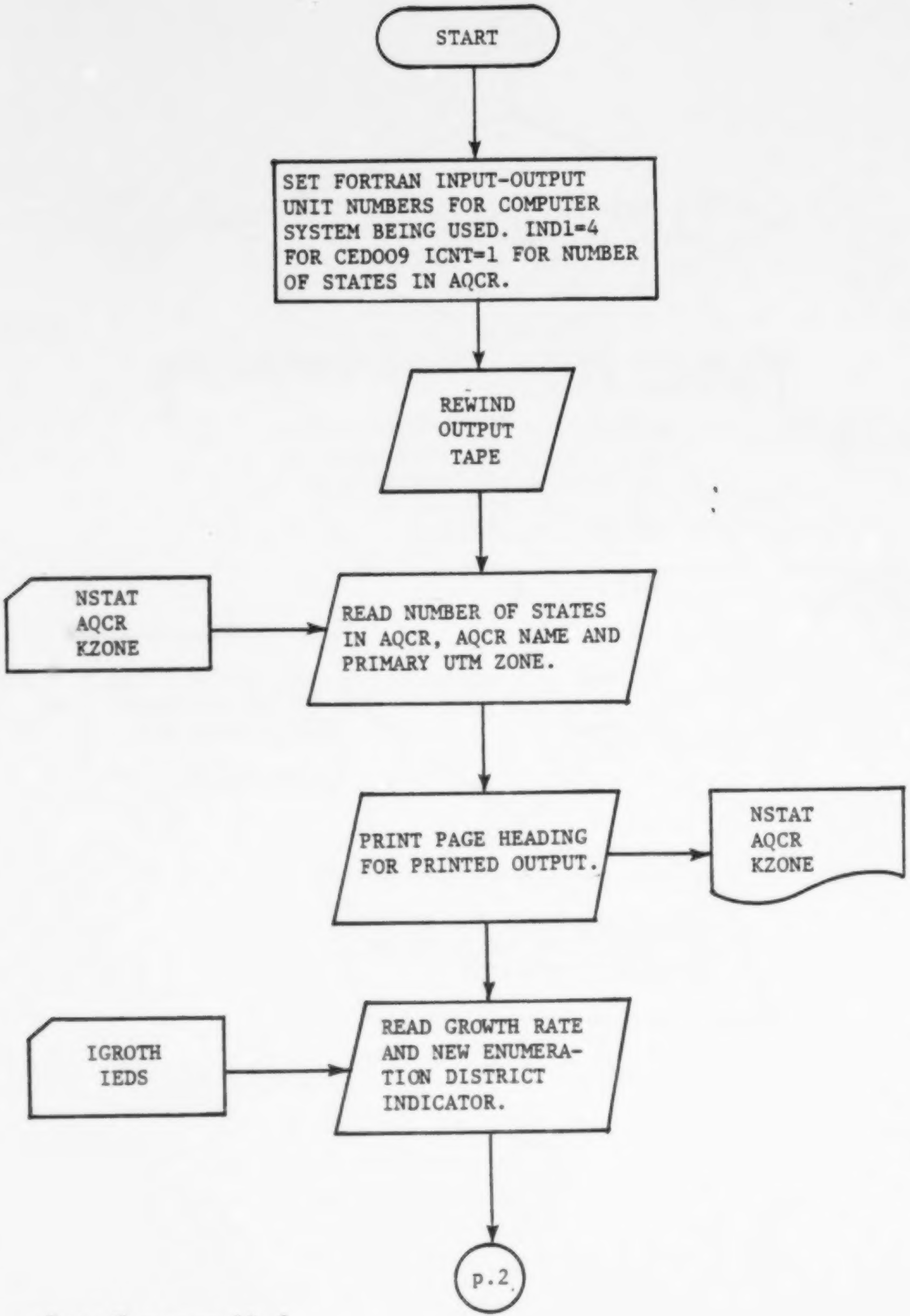
If the CAASE user does not want CAASE4 to assign apportioning factors for a source category, then there are two easy ways to do this:

1. In running the CAASE4 program, the source category can be initialized to 0.0 and then no user-provided weighting factors are input. The zero coefficient for apportioning will effectively eliminate the source category.
2. In running the CAASE5 program, the source category fuels (throughput) on the Area Source Input card can be set to zero. In this case, no overriding action is necessary in running CAASE4.

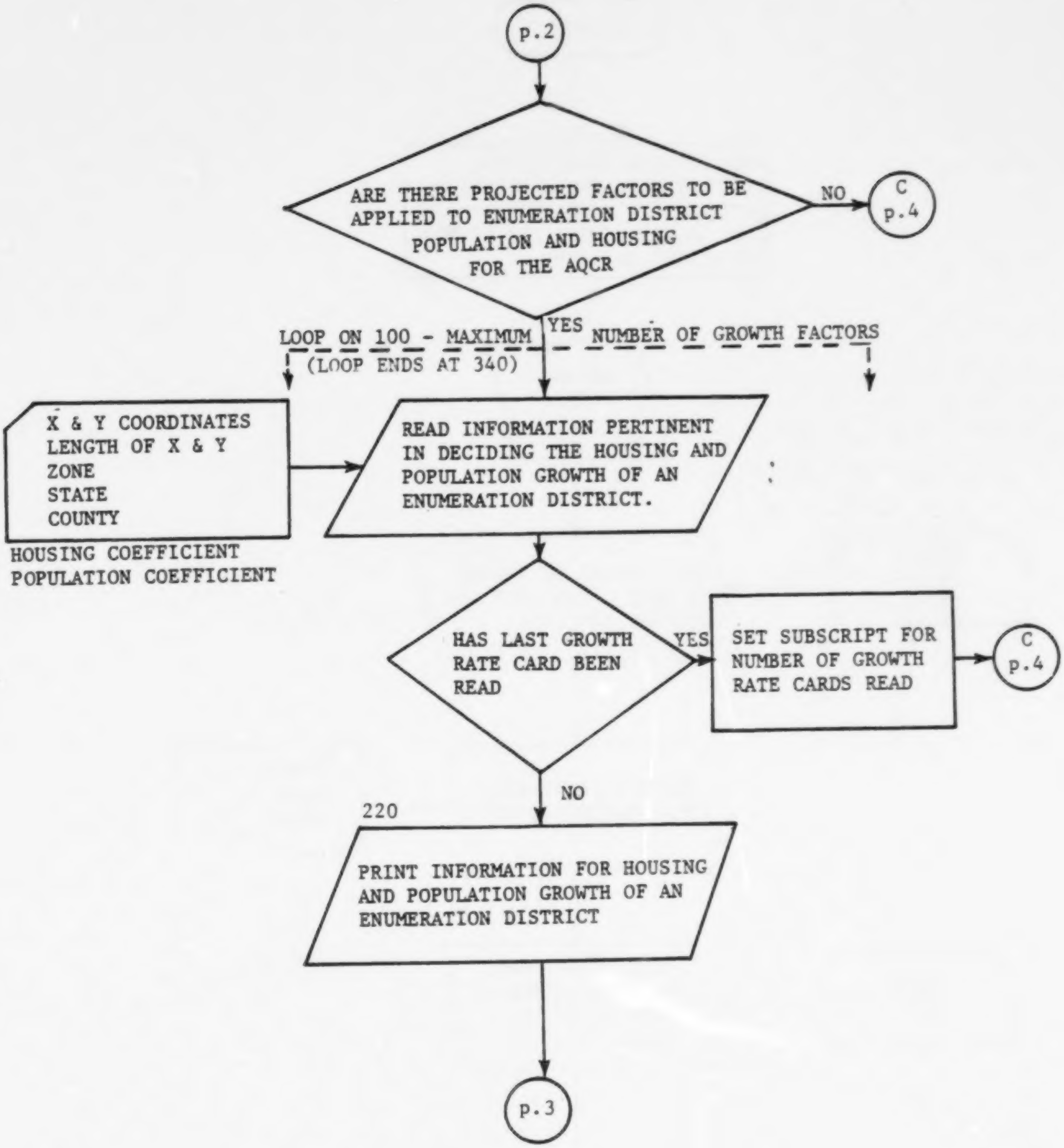
In either case above, the CAASE5 output tables would display a zero for all grid squares for the source category so excluded. Also, emissions for the source category would not be included in the grid square totals output on the dispersion model card images. The emissions for the source category could be calculated by another method and allocated manually by the user. These emissions could then be added, as appropriate, to the totals on the dispersion model card images output by CAASE5.

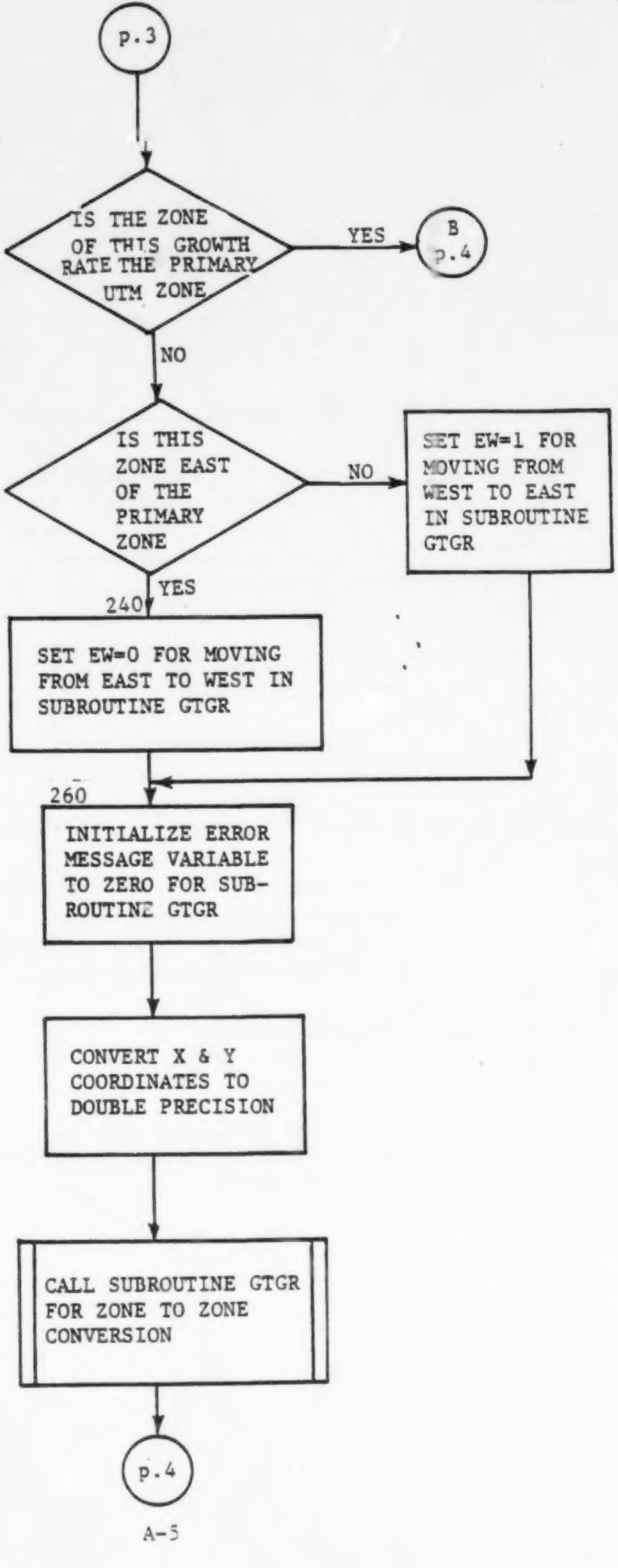
APPENDIX A

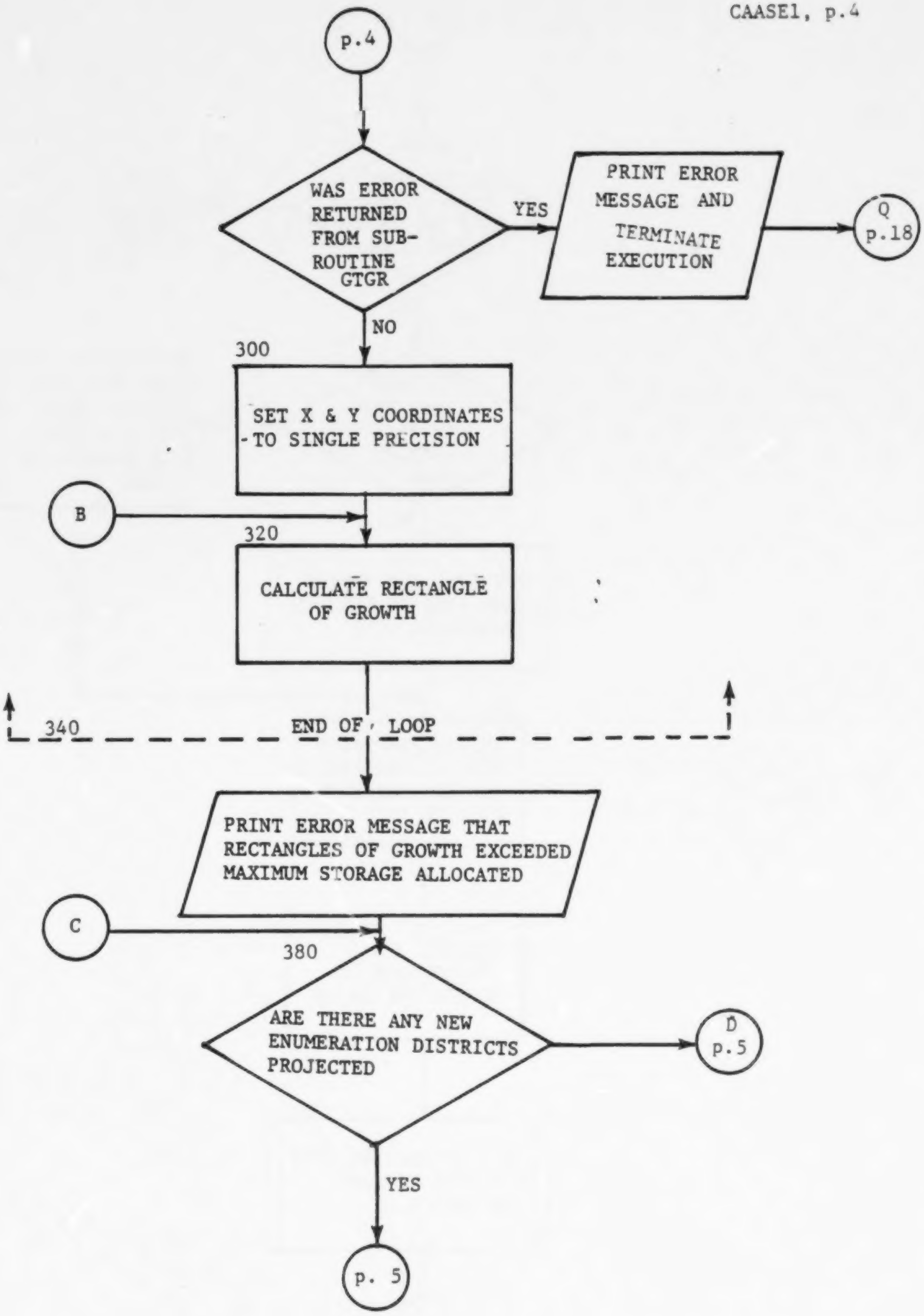
LOGICAL FLOWCHARTS AND FORTRAN SOURCE CODE LISTINGS
CAASE1 (and Subroutines)

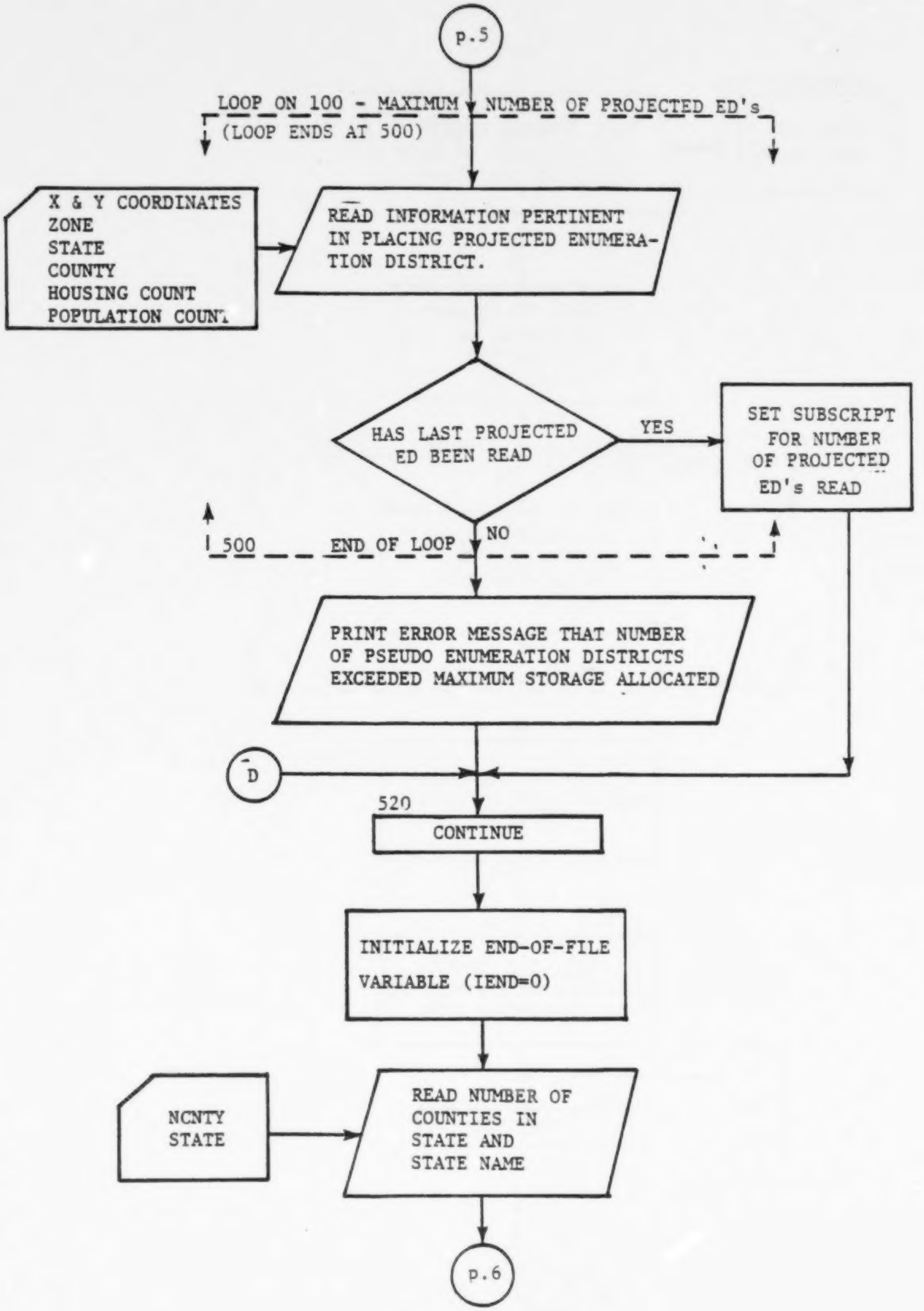

START
SET FORTRAN INPUT-OUTPUT UNIT NUMBERS FOR COMPUTER SYSTEM BEING USED. IND1=4 FOR CED009 ICNT=1 FOR NUMBER OF STATES IN AQCR.
REWIND OUTPUT TAPE
NSTAT
AQCR
KZONE
READ NUMBER OF STATES IN AQCR, AQCR NAME AND PRIMARY UTM ZONE.
PRINT PAGE HEADING FOR PRINTED OUTPUT.
NSTAT
AQCR
KZONE
IGROTH
IEDS
READ GROWTH RATE AND NEW ENUMERATION DISTRICT INDICATOR.
p.2

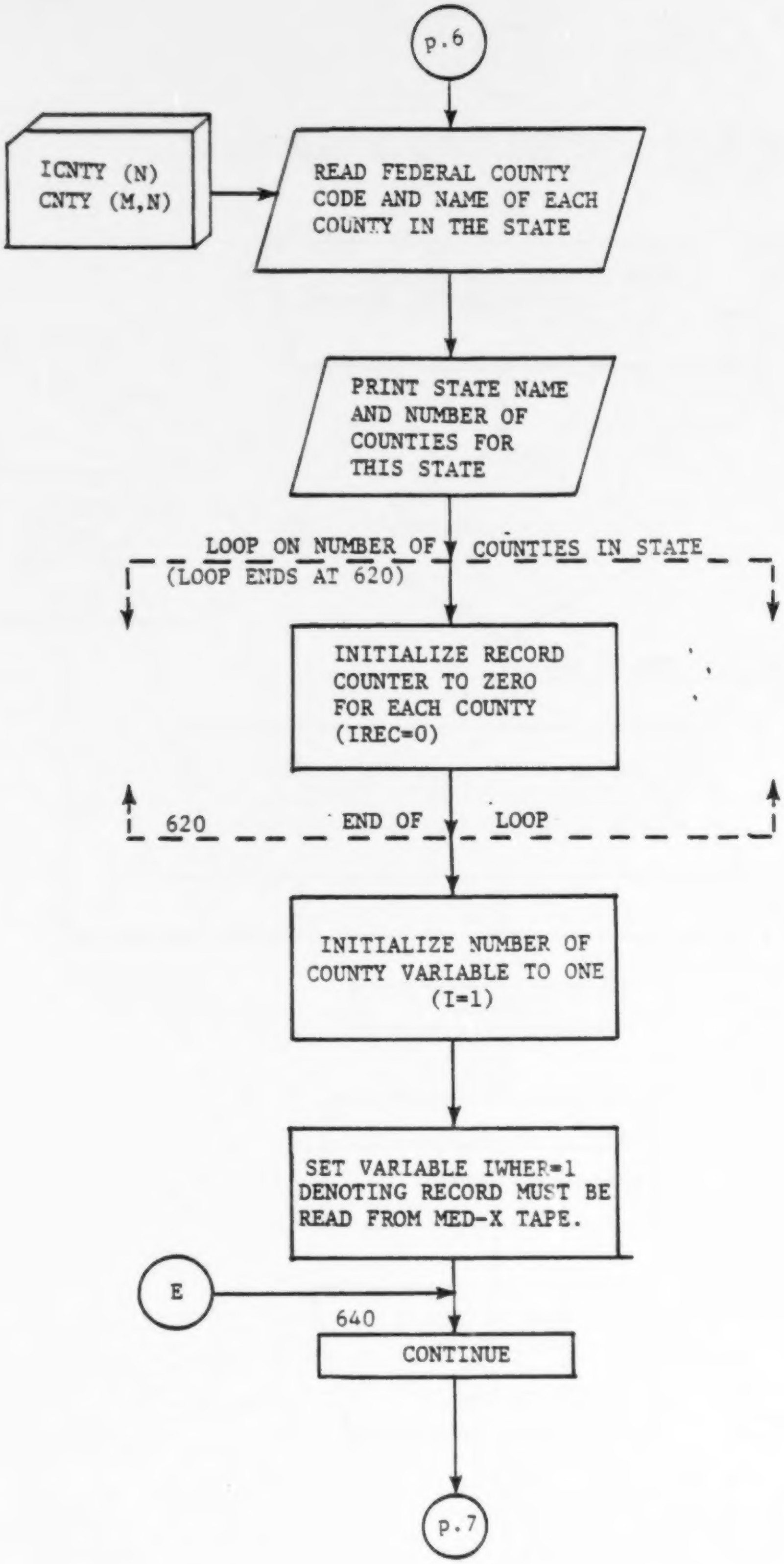
Preceding page blank

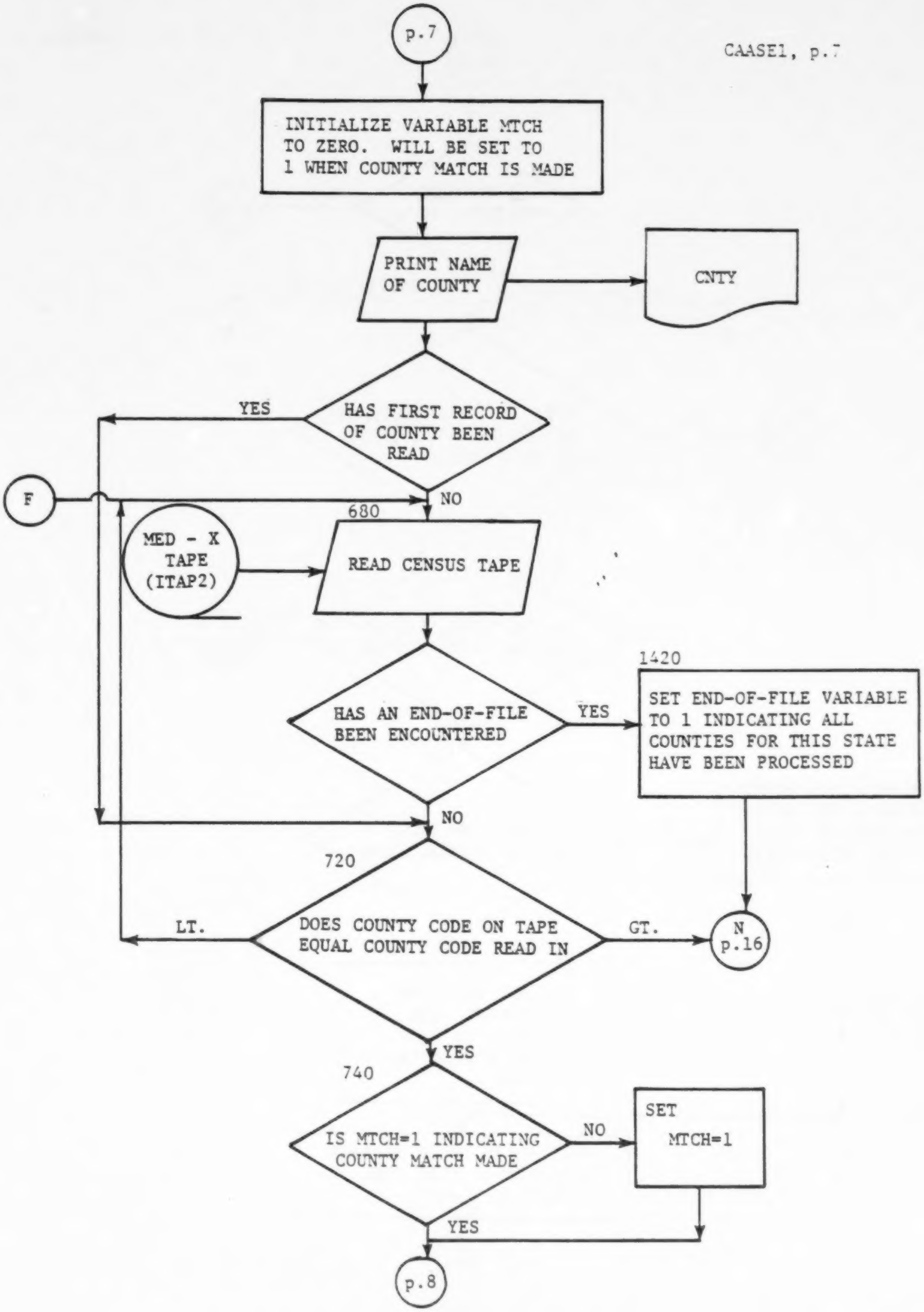

p.2
ARE THERE PROJECTED FACTORS TO BE APPLIED TO ENUMERATION DISTRICT POPULATION AND HOUSING FOR THE AQCR
NO
C p.4
YES
LOOP ON 100 - MAXIMUM NUMBER OF GROWTH FACTORS
(LOOP ENDS AT 340)
X & Y COORDINATES
LENGTH OF X & Y
ZONE
STATE
COUNTY
HOUSING COEFFICIENT
POPULATION COEFFICIENT
READ INFORMATION PERTINENT IN DECIDING THE HOUSING AND POPULATION GROWTH OF AN ENUMERATION DISTRICT.
HAS LAST GROWTH RATE CARD BEEN READ
YES
SET SUBSCRIPT FOR NUMBER OF GROWTH RATE CARDS READ
C p.4
NO
220
PRINT INFORMATION FOR HOUSING AND POPULATION GROWTH OF AN ENUMERATION DISTRICT
p.3

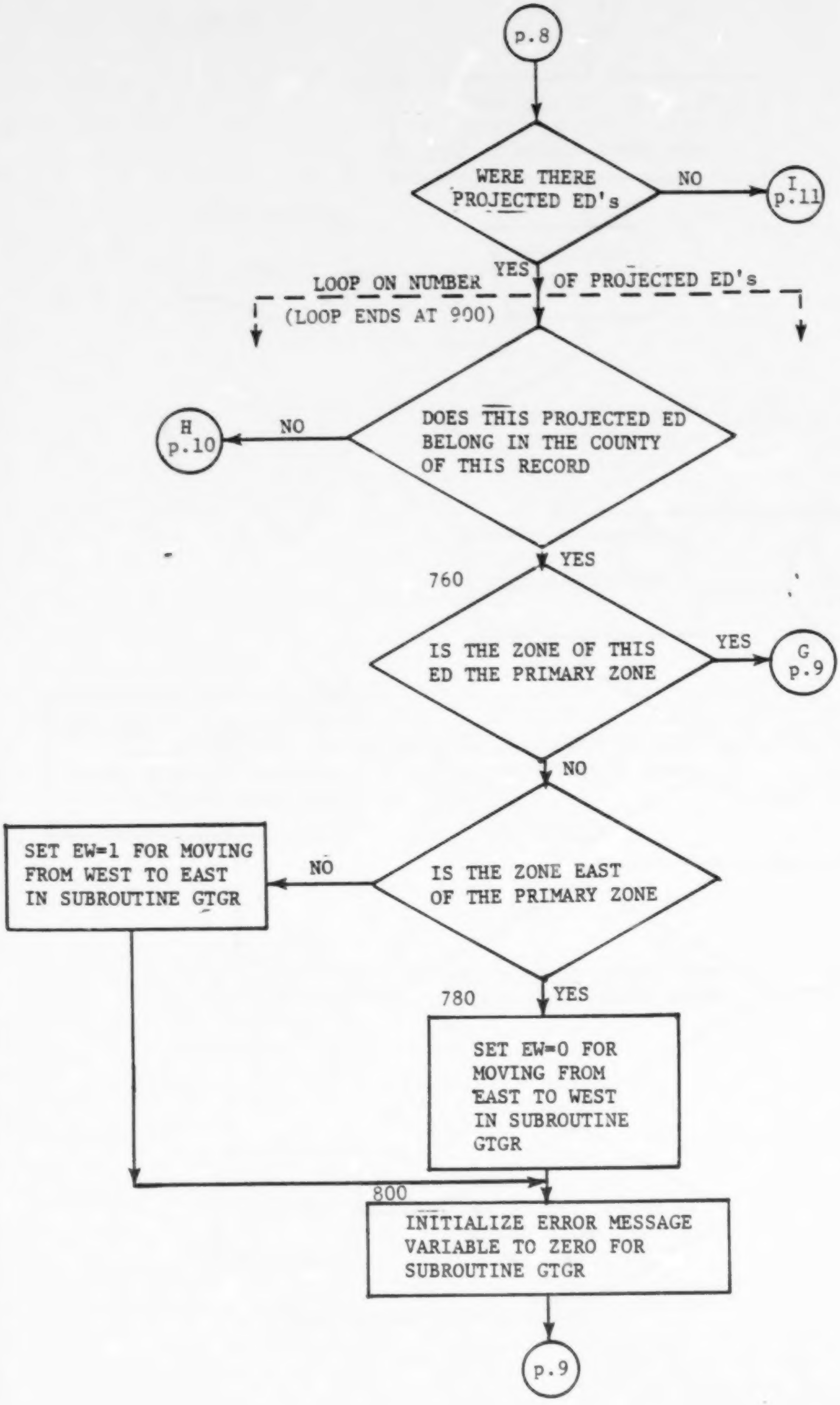

p.3
IS THE ZONE OF THIS GROWTH RATE THE PRIMARY UTM ZONE
YES
B
p.4
NO
IS THIS ZONE EAST OF THE PRIMARY ZONE
NO
SET EW=1 FOR MOVING FROM WEST TO EAST IN SUBROUTINE GTGR
YES
240
SET EW=0 FOR MOVING FROM EAST TO WEST IN SUBROUTINE GTGR
260
INITIALIZE ERROR MESSAGE VARIABLE TO ZERO FOR SUB-ROUTINE GTGR
CONVERT X & Y COORDINATES TO DOUBLE PRECISION
CALL SUBROUTINE GTGR FOR ZONE TO ZONE CONVERSION
p.4

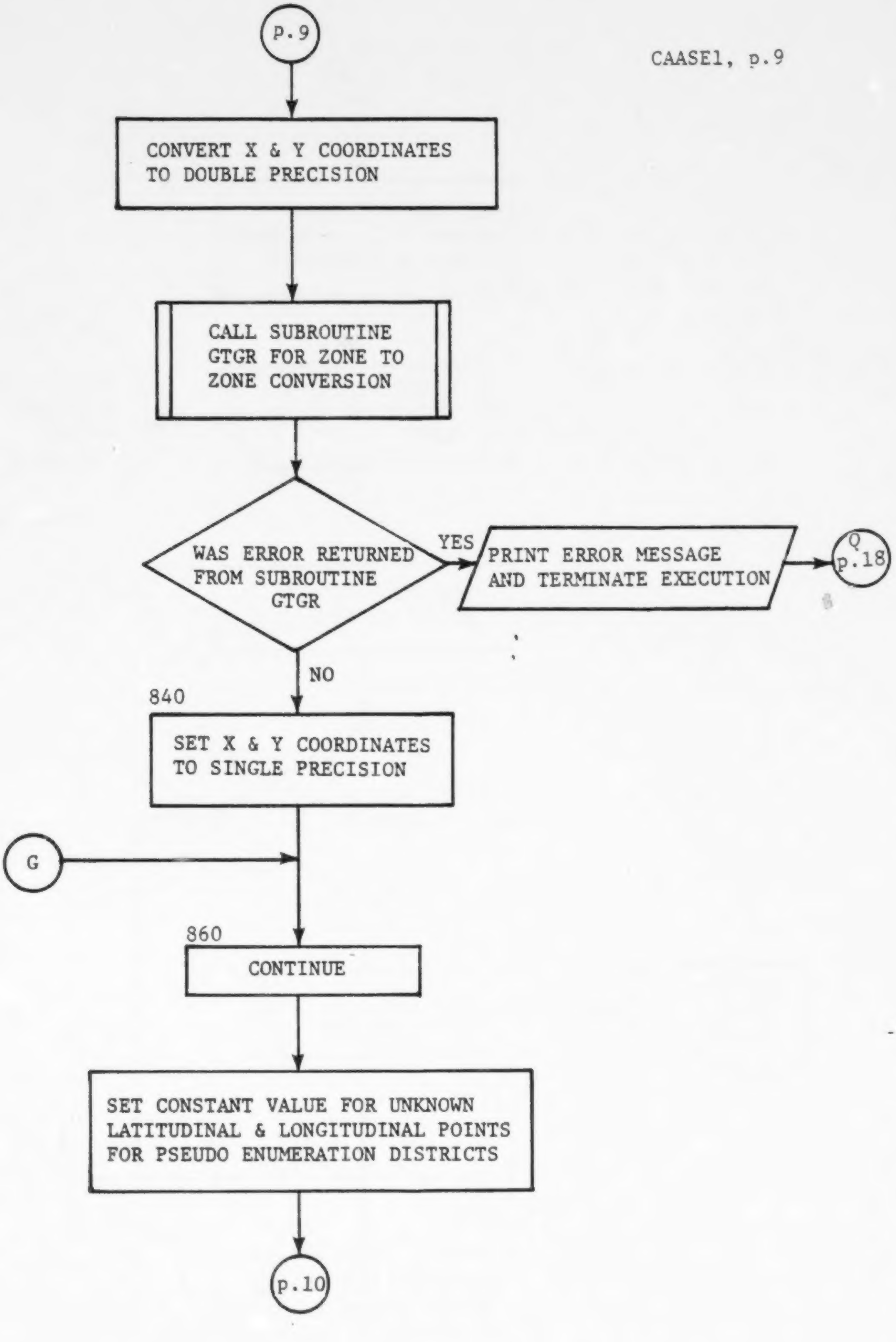

p.4
WAS ERROR RETURNED FROM SUB-ROUTINE GTGR
YES
PRINT ERROR MESSAGE AND TERMINATE EXECUTION
Q p.18
NO
300
SET X & Y COORDINATES TO SINGLE PRECISION
B
320
CALCULATE RECTANGLE OF GROWTH
340
END OF LOOP
PRINT ERROR MESSAGE THAT RECTANGLES OF GROWTH EXCEEDED MAXIMUM STORAGE ALLOCATED
C
380
ARE THERE ANY NEW ENUMERATION DISTRICTS PROJECTED
D p.5
YES
p. 5

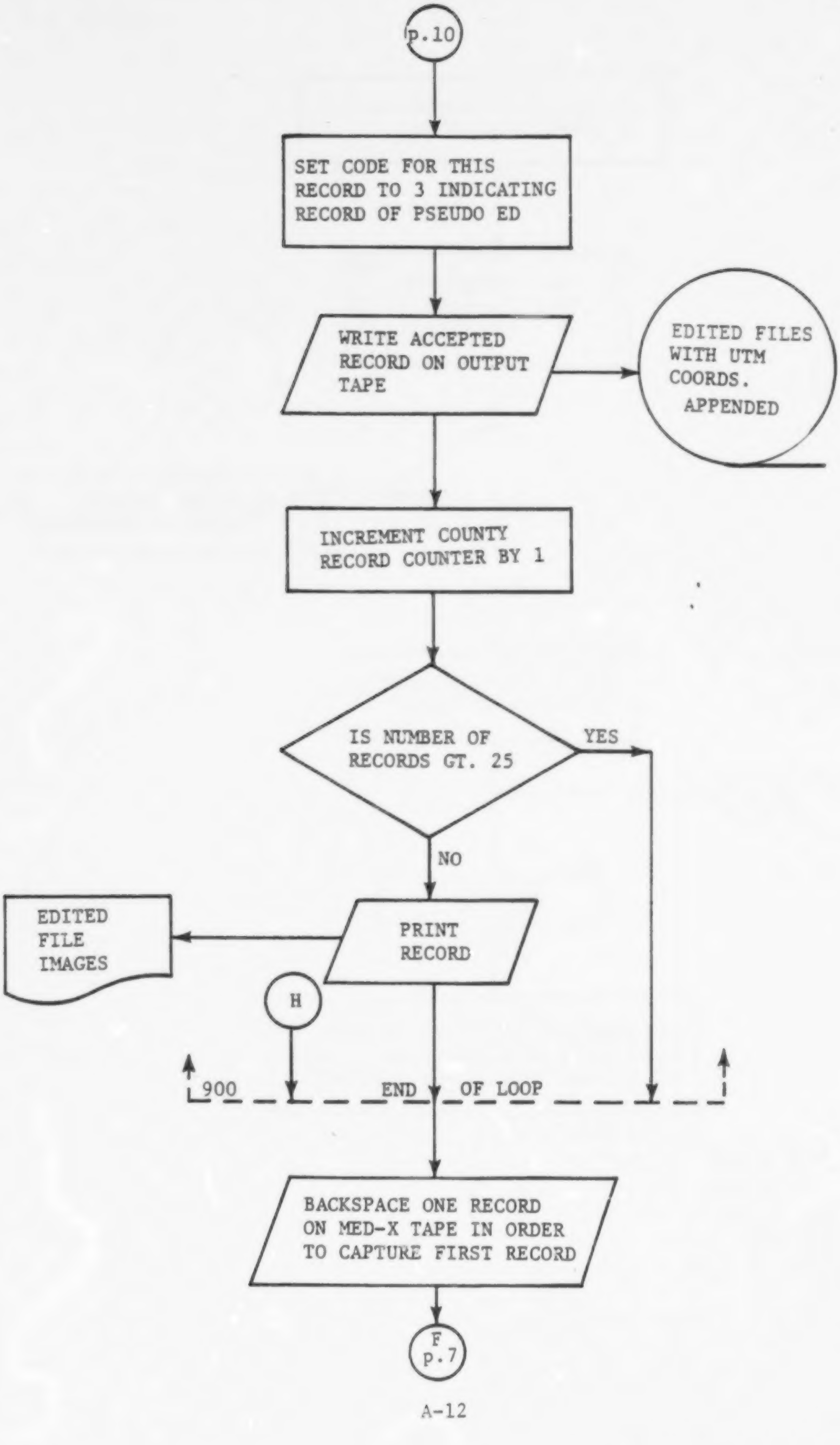

p.5
LOOP ON 100 - MAXIMUM NUMBER OF PROJECTED ED's
(LOOP ENDS AT 500)
X & Y COORDINATES
ZONE
STATE
COUNTY
HOUSING COUNT
POPULATION COUNT
READ INFORMATION PERTINENT IN PLACING PROJECTED ENUMERATION DISTRICT.
HAS LAST PROJECTED ED BEEN READ
YES
SET SUBSCRIPT FOR NUMBER OF PROJECTED ED's READ
NO
500
END OF LOOP
PRINT ERROR MESSAGE THAT NUMBER OF PSEUDO ENUMERATION DISTRICTS EXCEEDED MAXIMUM STORAGE ALLOCATED
D
520
CONTINUE
INITIALIZE END-OF-FILE VARIABLE (IEND=0)
NCNTY
STATE
READ NUMBER OF COUNTIES IN STATE AND STATE NAME
p.6

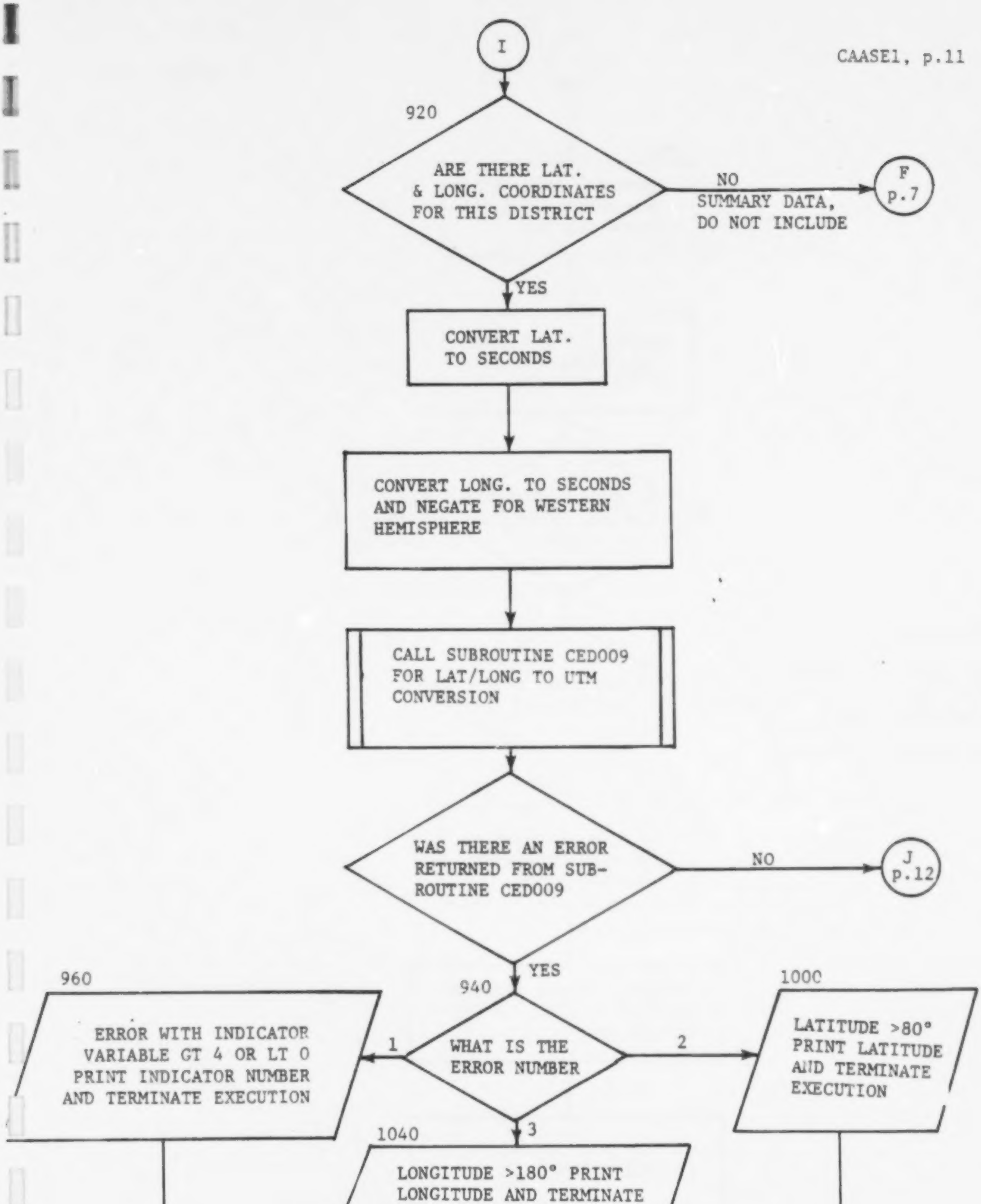

p.6
ICNTY (N)
CNTY (M,N)
READ FEDERAL COUNTY CODE AND NAME OF EACH COUNTY IN THE STATE
PRINT STATE NAME AND NUMBER OF COUNTIES FOR THIS STATE
LOOP ON NUMBER OF COUNTIES IN STATE
(LOOP ENDS AT 620)
INITIALIZE RECORD COUNTER TO ZERO FOR EACH COUNTY (IREC=0)
620
END OF LOOP
INITIALIZE NUMBER OF COUNTY VARIABLE TO ONE (I=1)
SET VARIABLE IWHER=1 DENOTING RECORD MUST BE READ FROM MED-X TAPE.
E
640
CONTINUE
p.7

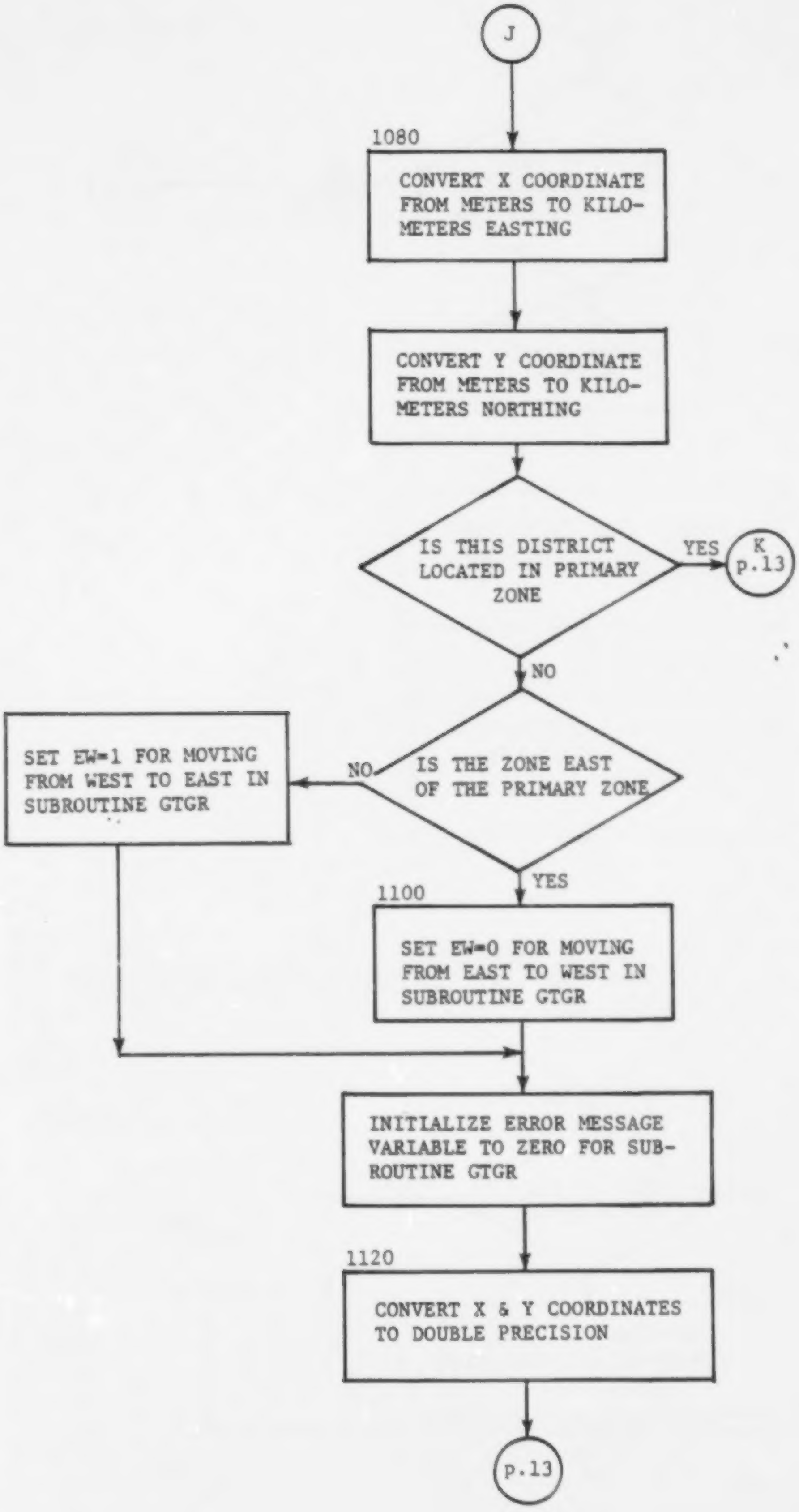

p.7
INITIALIZE VARIABLE MTCH TO ZERO. WILL BE SET TO 1 WHEN COUNTY MATCH IS MADE
PRINT NAME OF COUNTY
CNTY
HAS FIRST RECORD OF COUNTY BEEN READ
YES
NO
F
680
MED - X TAPE (ITAP2)
READ CENSUS TAPE
HAS AN END-OF-FILE BEEN ENCOUNTERED
YES
NO
1420
SET END-OF-FILE VARIABLE TO 1 INDICATING ALL COUNTIES FOR THIS STATE HAVE BEEN PROCESSED
720
DOES COUNTY CODE ON TAPE EQUAL COUNTY CODE READ IN
LT.
GT.
N p.16
YES
740
IS MTCH=1 INDICATING COUNTY MATCH MADE
NO
SET MTCH=1
YES
p.8

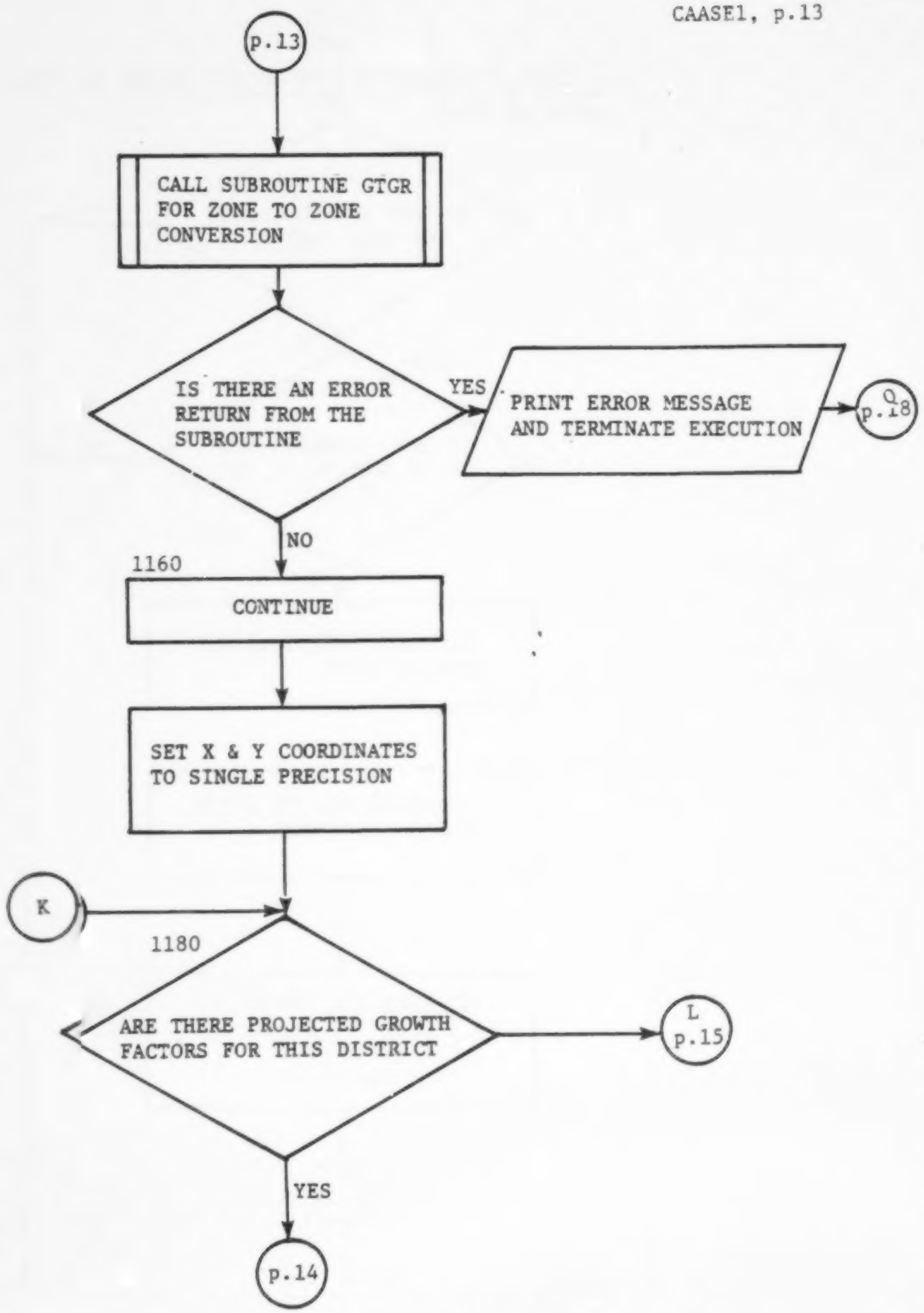

p.8
WERE THERE PROJECTED ED's
NO
I p.11
YES
LOOP ON NUMBER OF PROJECTED ED's
(LOOP ENDS AT 900)
DOES THIS PROJECTED ED BELONG IN THE COUNTY OF THIS RECORD
NO
H p.10
YES
760
IS THE ZONE OF THIS ED THE PRIMARY ZONE
YES
G p.9
NO
IS THE ZONE EAST OF THE PRIMARY ZONE
NO
SET EW=1 FOR MOVING FROM WEST TO EAST IN SUBROUTINE GTGR
YES
780
SET EW=0 FOR MOVING FROM EAST TO WEST IN SUBROUTINE GTGR
800
INITIALIZE ERROR MESSAGE VARIABLE TO ZERO FOR SUBROUTINE GTGR
p.9

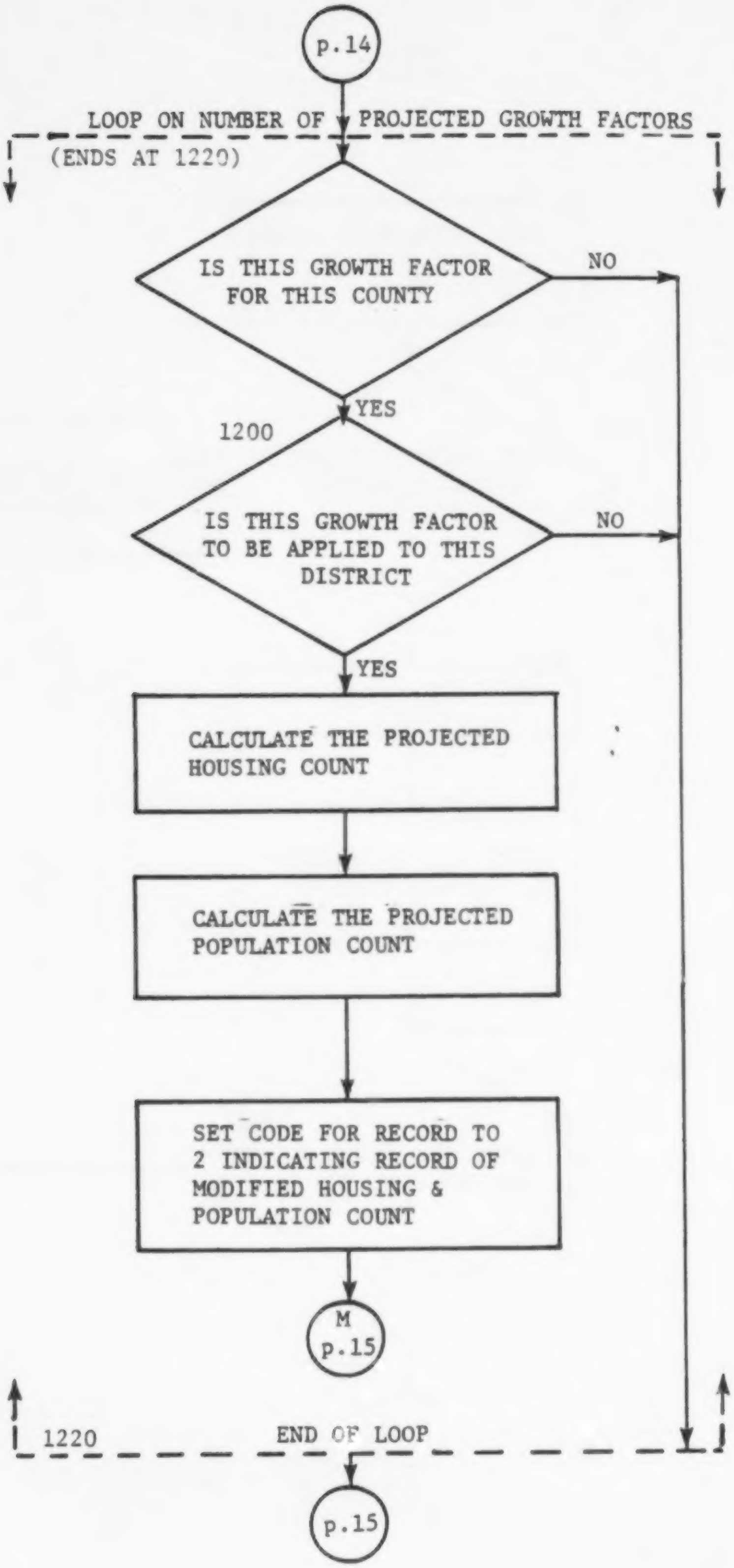

p.9
CONVERT X & Y COORDINATES TO DOUBLE PRECISION
CALL SUBROUTINE GTGR FOR ZONE TO ZONE CONVERSION
WAS ERROR RETURNED FROM SUBROUTINE GTGR
YES
PRINT ERROR MESSAGE AND TERMINATE EXECUTION
Q
p.18
NO
840
SET X & Y COORDINATES TO SINGLE PRECISION
G
860
CONTINUE
SET CONSTANT VALUE FOR UNKNOWN LATITUDINAL & LONGITUDINAL POINTS FOR PSEUDO ENUMERATION DISTRICTS
p.10

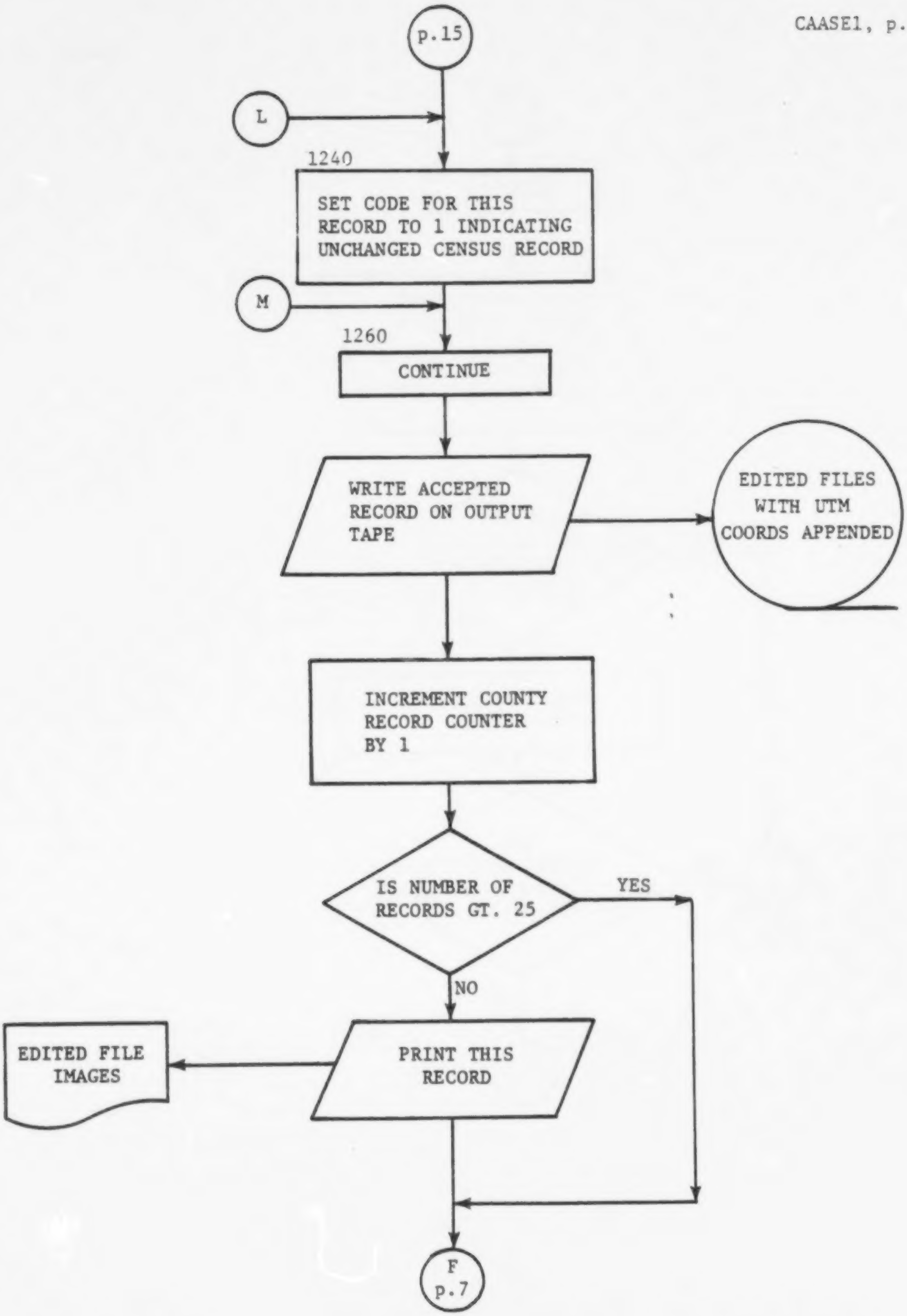

p.10
SET CODE FOR THIS RECORD TO 3 INDICATING RECORD OF PSEUDO ED
WRITE ACCEPTED RECORD ON OUTPUT TAPE
EDITED FILES WITH UTM COORDS. APPENDED
INCREMENT COUNTY RECORD COUNTER BY 1
IS NUMBER OF RECORDS GT. 25
YES
NO
PRINT RECORD
EDITED FILE IMAGES
H
900
END OF LOOP
BACKSPACE ONE RECORD ON MED-X TAPE IN ORDER TO CAPTURE FIRST RECORD
F p.7

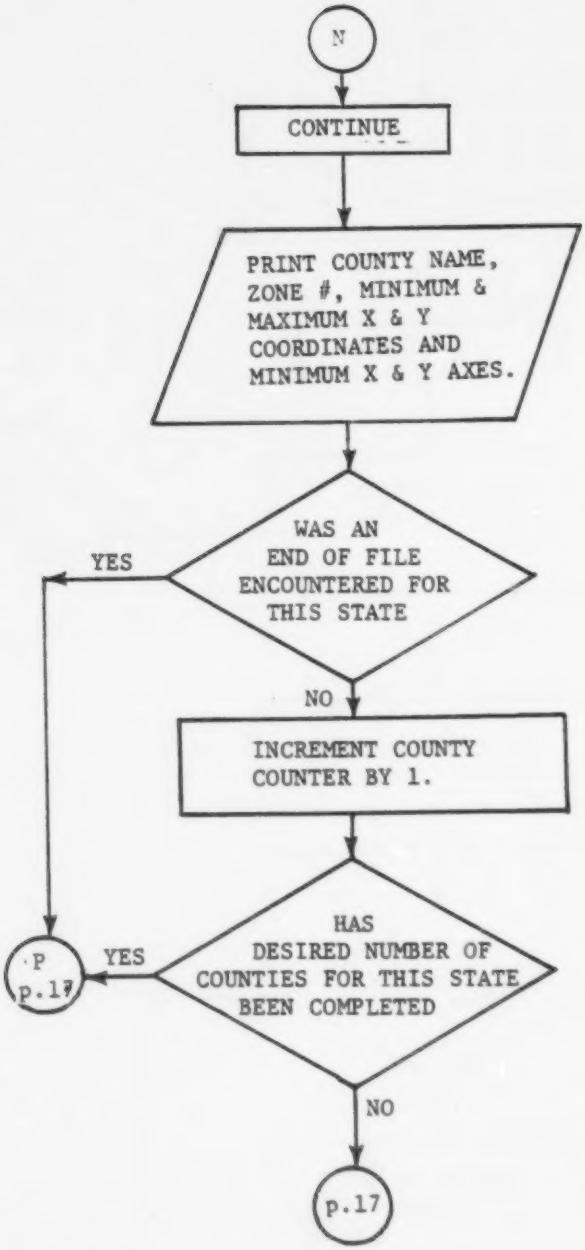

I
920
ARE THERE LAT. & LONG. COORDINATES FOR THIS DISTRICT
NO
SUMMARY DATA, DO NOT INCLUDE
F p.7
YES
CONVERT LAT. TO SECONDS
CONVERT LONG. TO SECONDS AND NEGATE FOR WESTERN HEMISPHERE
CALL SUBROUTINE CED009 FOR LAT/LONG TO UTM CONVERSION
WAS THERE AN ERROR RETURNED FROM SUB-ROUTINE CED009
NO
J p.12
YES
940
WHAT IS THE ERROR NUMBER
1
2
3
960
ERROR WITH INDICATOR VARIABLE GT 4 OR LT 0 PRINT INDICATOR NUMBER AND TERMINATE EXECUTION
1000
LATITUDE >80° PRINT LATITUDE AND TERMINATE EXECUTION
1040
LONGITUDE >180° PRINT LONGITUDE AND TERMINATE EXECUTION
Q p.18

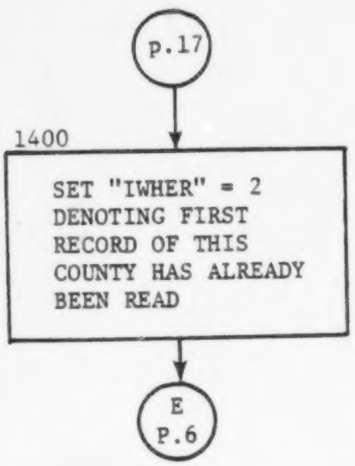

J
1080
CONVERT X COORDINATE FROM METERS TO KILOMETERS EASTING
CONVERT Y COORDINATE FROM METERS TO KILOMETERS NORTHING
IS THIS DISTRICT LOCATED IN PRIMARY ZONE
YES
K p.13
NO
IS THE ZONE EAST OF THE PRIMARY ZONE
NO
SET EW=1 FOR MOVING FROM WEST TO EAST IN SUBROUTINE GTGR
YES
1100
SET EW=0 FOR MOVING FROM EAST TO WEST IN SUBROUTINE GTGR
INITIALIZE ERROR MESSAGE VARIABLE TO ZERO FOR SUBROUTINE GTGR
1120
CONVERT X & Y COORDINATES TO DOUBLE PRECISION
p.13

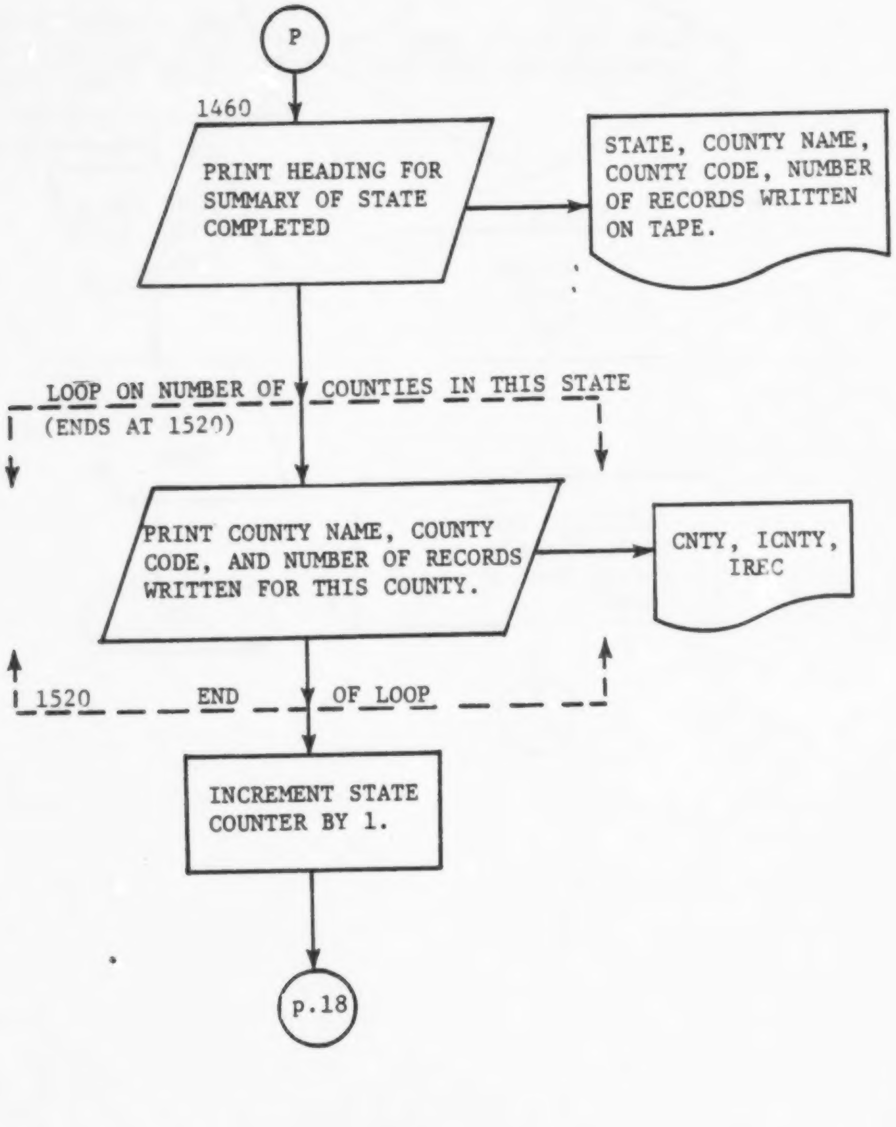

p.13
CALL SUBROUTINE GTGR FOR ZONE TO ZONE CONVERSION
IS THERE AN ERROR RETURN FROM THE SUBROUTINE
YES
PRINT ERROR MESSAGE AND TERMINATE EXECUTION
Q
p.18
NO
1160
CONTINUE
SET X & Y COORDINATES TO SINGLE PRECISION
K
1180
ARE THERE PROJECTED GROWTH FACTORS FOR THIS DISTRICT
L
p.15
YES
p.14

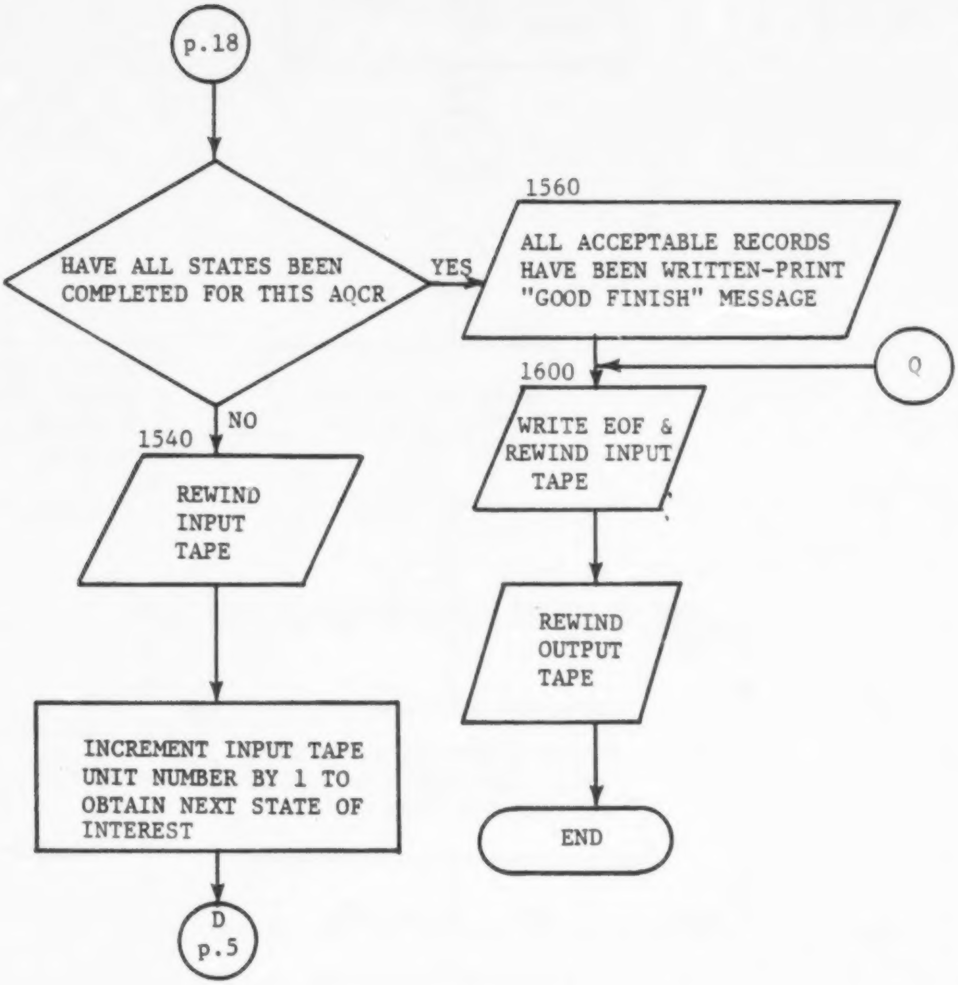

p.14
LOOP ON NUMBER OF PROJECTED GROWTH FACTORS
(ENDS AT 1220)
IS THIS GROWTH FACTOR FOR THIS COUNTY
NO
YES
1200
IS THIS GROWTH FACTOR TO BE APPLIED TO THIS DISTRICT
NO
YES
CALCULATE THE PROJECTED HOUSING COUNT
CALCULATE THE PROJECTED POPULATION COUNT
SET CODE FOR RECORD TO 2 INDICATING RECORD OF MODIFIED HOUSING & POPULATION COUNT
M
p.15
1220
END OF LOOP
p.15

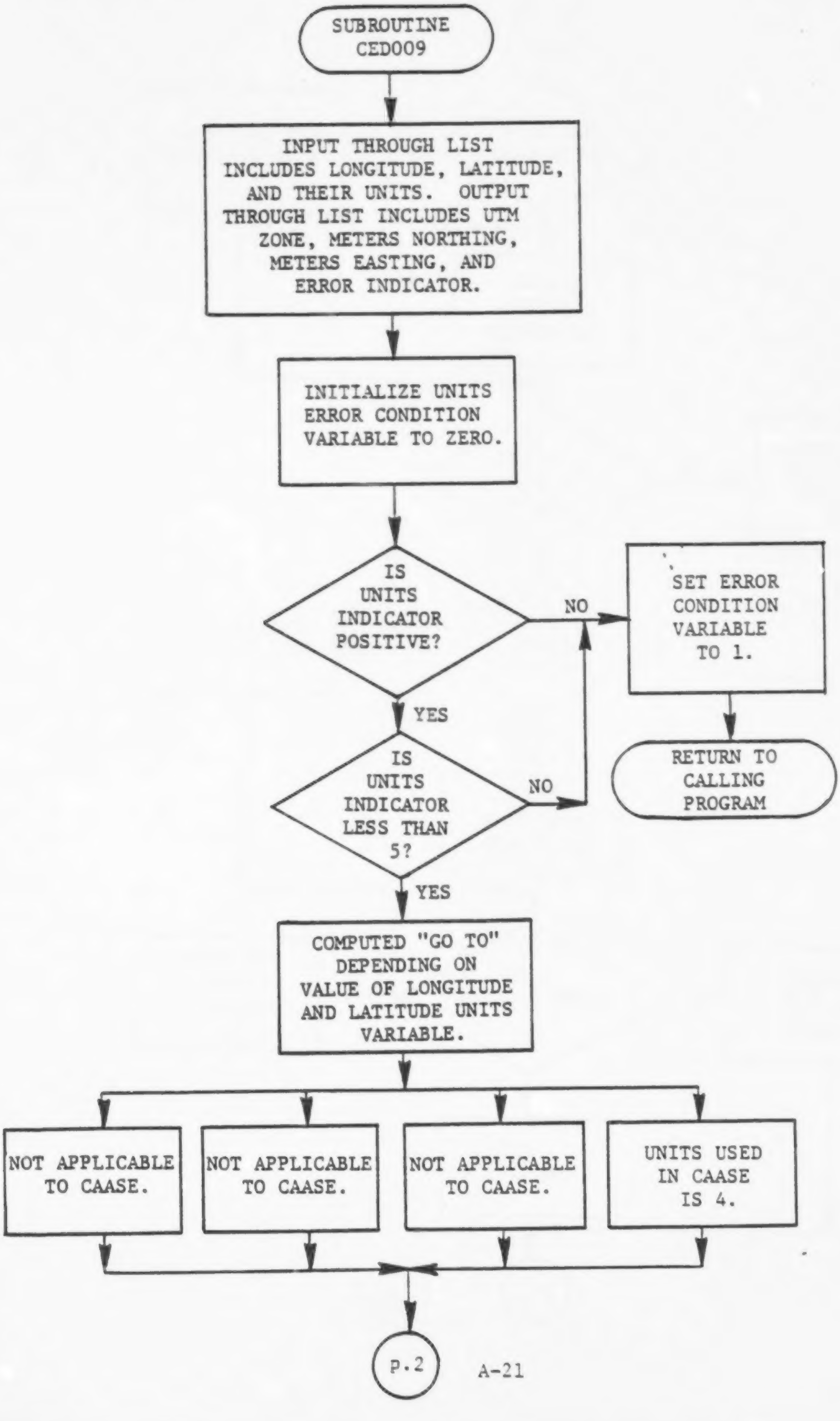

p.15
L
1240
SET CODE FOR THIS RECORD TO 1 INDICATING UNCHANGED CENSUS RECORD
M
1260
CONTINUE
WRITE ACCEPTED RECORD ON OUTPUT TAPE
EDITED FILES WITH UTM COORDS APPENDED
INCREMENT COUNTY RECORD COUNTER BY 1
IS NUMBER OF RECORDS GT. 25
YES
NO
PRINT THIS RECORD
EDITED FILE IMAGES
F
p.7

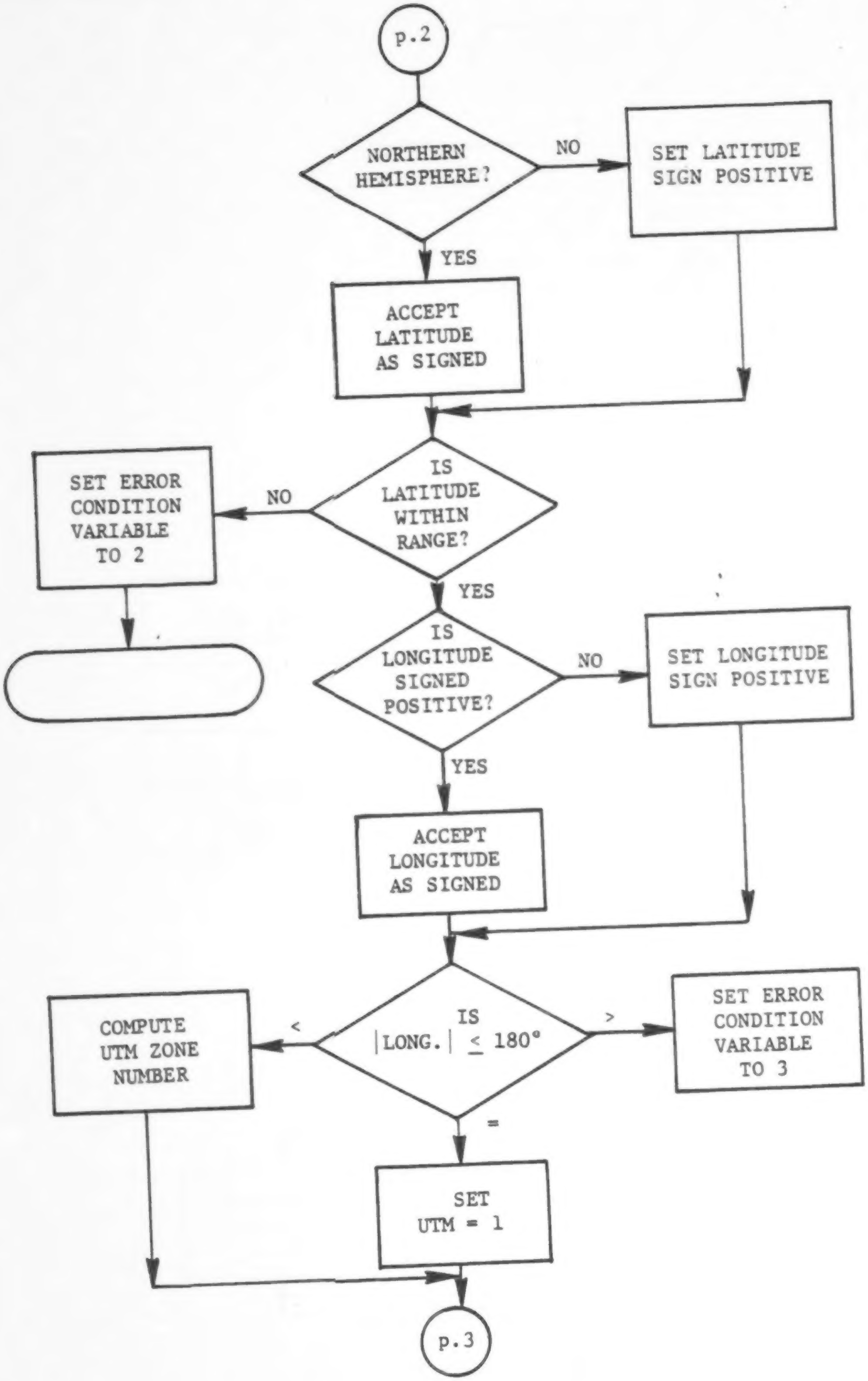

N
CONTINUE
PRINT COUNTY NAME, ZONE #, MINIMUM & MAXIMUM X & Y COORDINATES AND MINIMUM X & Y AXES.
WAS AN END OF FILE ENCOUNTERED FOR THIS STATE
YES
NO
INCREMENT COUNTY COUNTER BY 1.
HAS DESIRED NUMBER OF COUNTIES FOR THIS STATE BEEN COMPLETED
YES
P p.17
NO
p.17

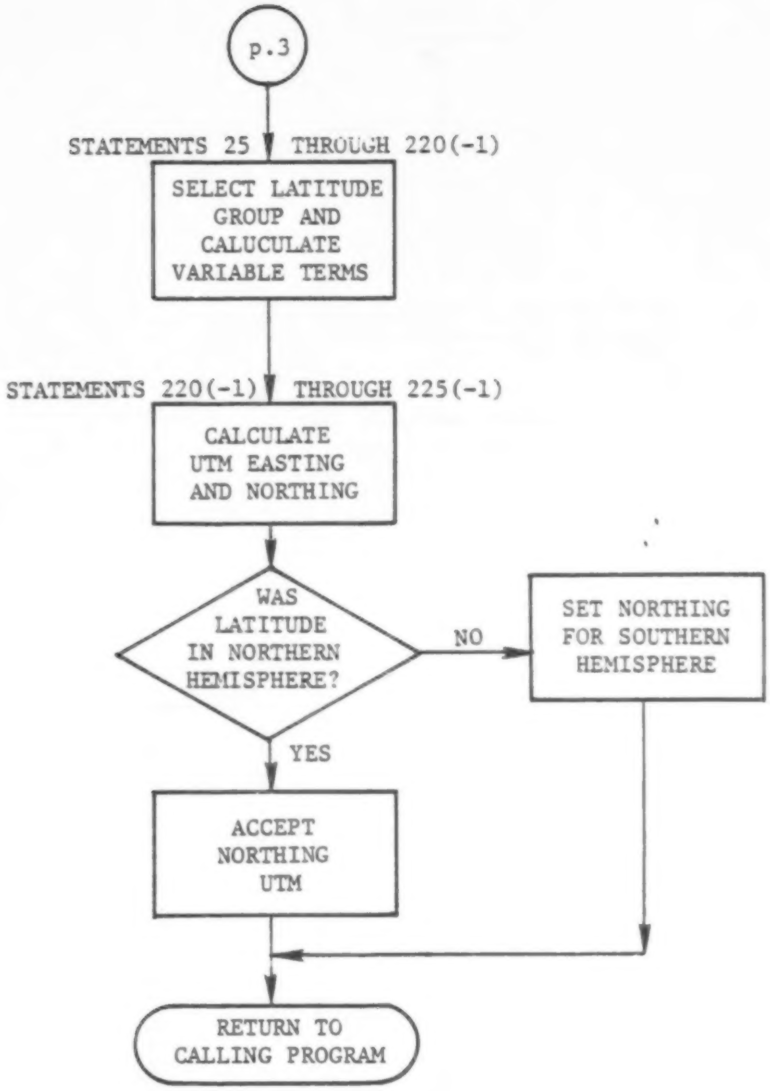

p.17
1400
SET "IWHER" = 2
DENOTING FIRST
RECORD OF THIS
COUNTY HAS ALREADY
BEEN READ
E
P.6

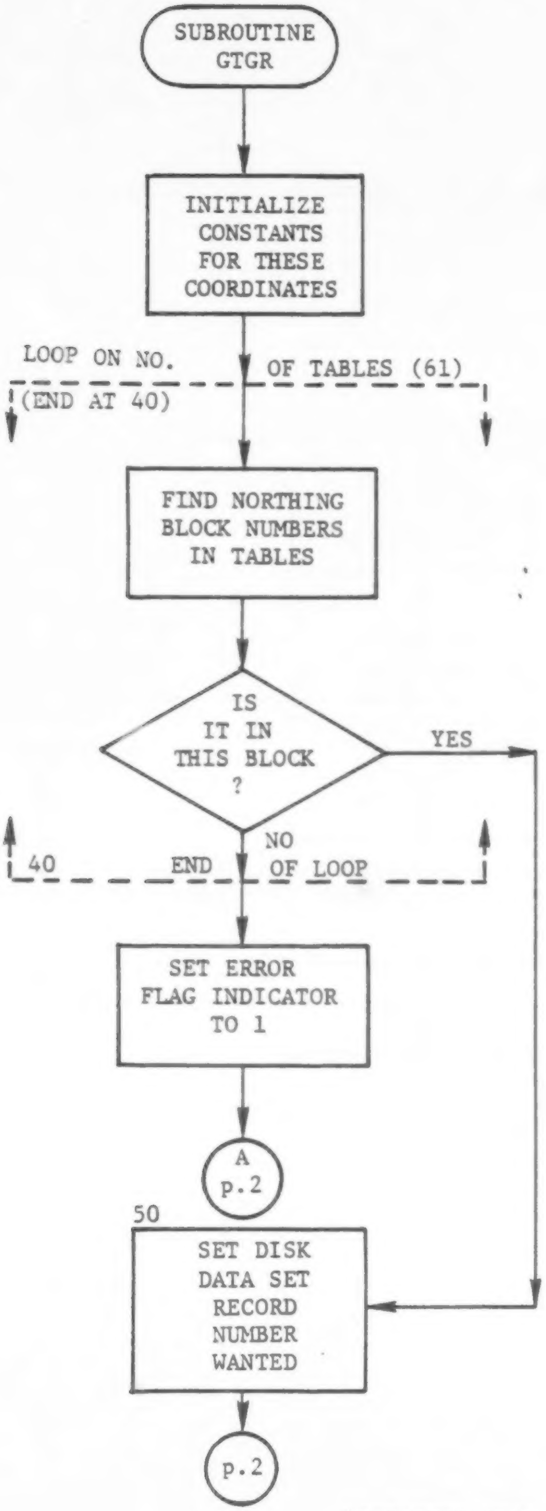

P
1460
PRINT HEADING FOR
SUMMARY OF STATE
COMPLETED
STATE, COUNTY NAME,
COUNTY CODE, NUMBER
OF RECORDS WRITTEN
ON TAPE.
LOOP ON NUMBER OF COUNTIES IN THIS STATE
(ENDS AT 1520)
PRINT COUNTY NAME, COUNTY
CODE, AND NUMBER OF RECORDS
WRITTEN FOR THIS COUNTY.
CNTY, ICNTY,
IREC
1520 END OF LOOP
INCREMENT STATE
COUNTER BY 1.
p.18


p.18
HAVE ALL STATES BEEN COMPLETED FOR THIS AQCR
YES
1560
ALL ACCEPTABLE RECORDS HAVE BEEN WRITTEN-PRINT "GOOD FINISH" MESSAGE
Q
1600
WRITE EOF & REWIND INPUT TAPE
REWIND OUTPUT TAPE
END
NO
1540
REWIND INPUT TAPE
INCREMENT INPUT TAPE UNIT NUMBER BY 1 TO OBTAIN NEXT STATE OF INTEREST
D p.5

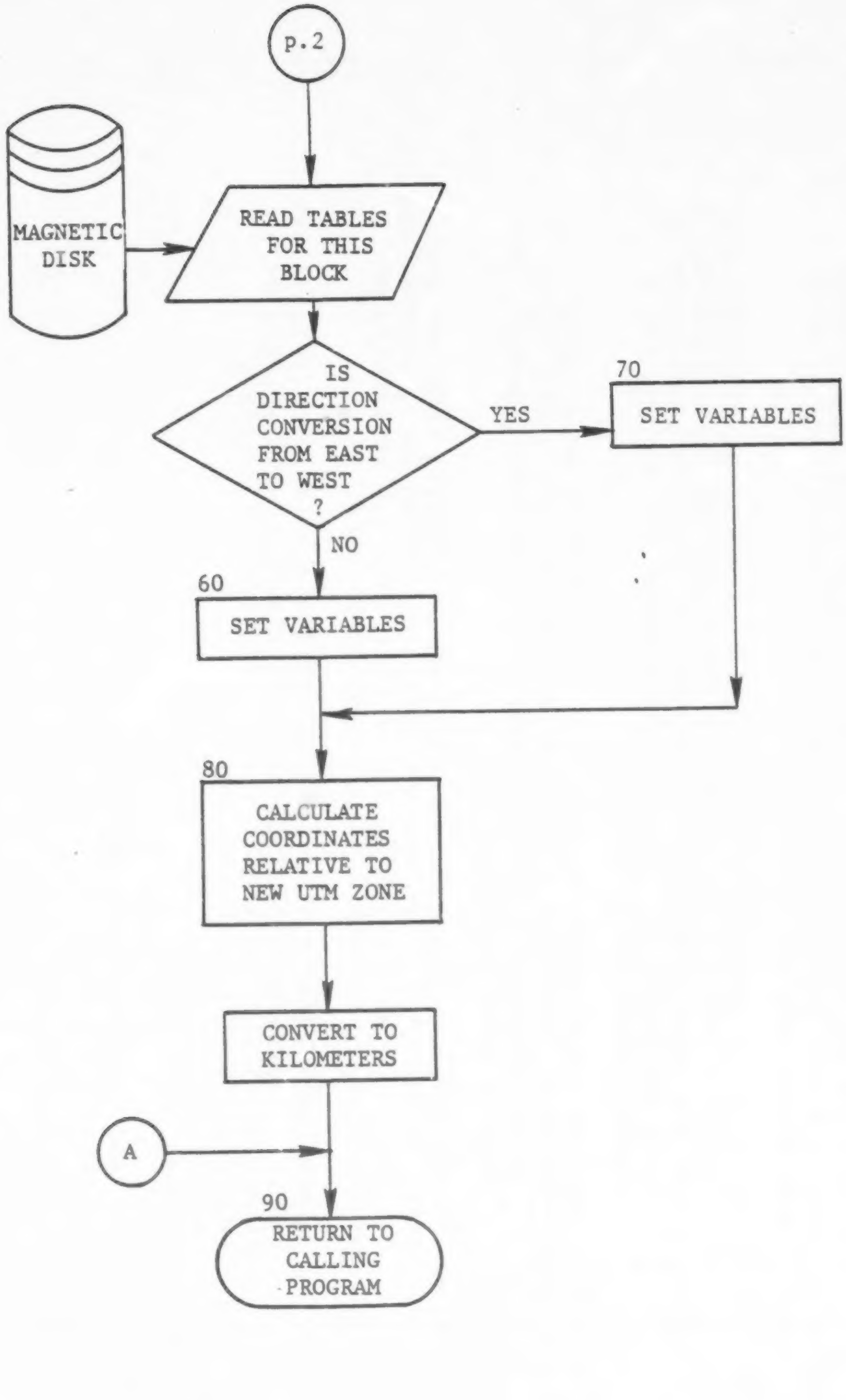

SUBROUTINE CED009
INPUT THROUGH LIST INCLUDES LONGITUDE, LATITUDE, AND THEIR UNITS. OUTPUT THROUGH LIST INCLUDES UTM ZONE, METERS NORTHING, METERS EASTING, AND ERROR INDICATOR.
INITIALIZE UNITS ERROR CONDITION VARIABLE TO ZERO.
IS UNITS INDICATOR POSITIVE?
NO
SET ERROR CONDITION VARIABLE TO 1.
RETURN TO CALLING PROGRAM
YES
IS UNITS INDICATOR LESS THAN 5?
NO
YES
COMPUTED "GO TO" DEPENDING ON VALUE OF LONGITUDE AND LATITUDE UNITS VARIABLE.
NOT APPLICABLE TO CAASE.
NOT APPLICABLE TO CAASE.
NOT APPLICABLE TO CAASE.
UNITS USED IN CAASE IS 4.
P.2


p.2
NORTHERN HEMISPHERE?
NO
SET LATITUDE SIGN POSITIVE
YES
ACCEPT LATITUDE AS SIGNED
IS LATITUDE WITHIN RANGE?
NO
SET ERROR CONDITION VARIABLE TO 2
YES
IS LONGITUDE SIGNED POSITIVE?
NO
SET LONGITUDE SIGN POSITIVE
YES
ACCEPT LONGITUDE AS SIGNED
IS |LONG.| ≤ 180°
<
COMPUTE UTM ZONE NUMBER
>
SET ERROR CONDITION VARIABLE TO 3
=
SET UTM = 1
p.3

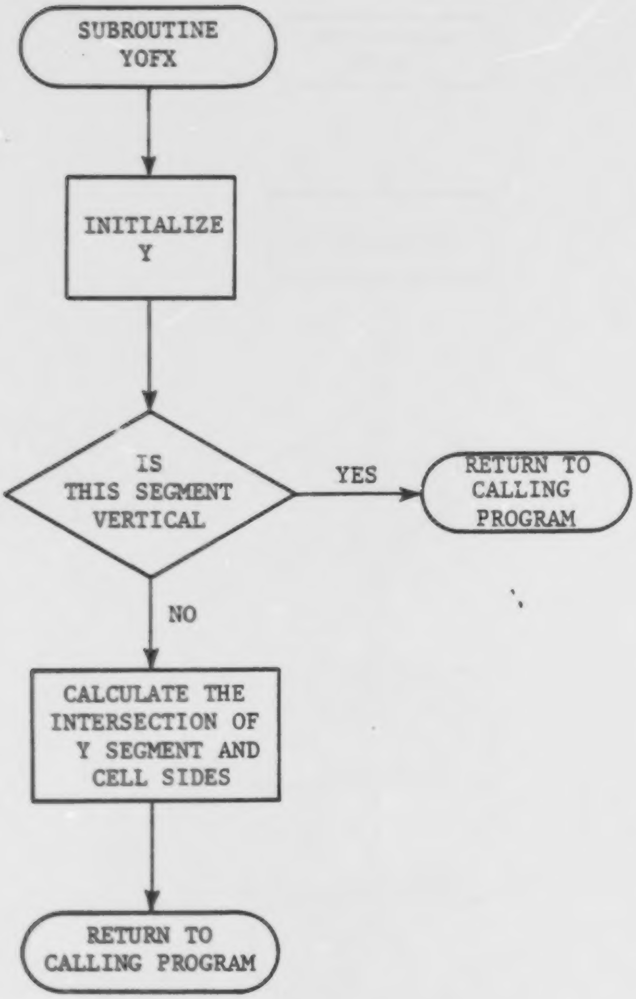

p.3
STATEMENTS 25 THROUGH 220(-1)
SELECT LATITUDE GROUP AND CALUCULATE VARIABLE TERMS
STATEMENTS 220(-1) THROUGH 225(-1)
CALCULATE UTM EASTING AND NORTHING
WAS LATITUDE IN NORTHERN HEMISPHERE?
NO
SET NORTHING FOR SOUTHERN HEMISPHERE
YES
ACCEPT NORTHING UTM
RETURN TO CALLING PROGRAM

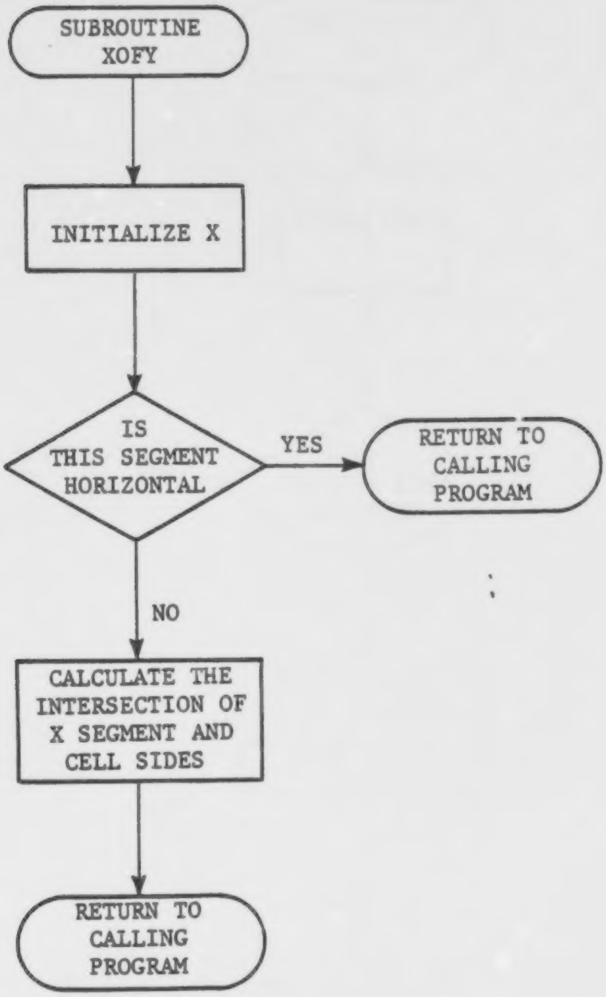

SUBROUTINE GTGR
INITIALIZE CONSTANTS FOR THESE COORDINATES
LOOP ON NO. OF TABLES (61)
(END AT 40)
FIND NORTHING BLOCK NUMBERS IN TABLES
IS IT IN THIS BLOCK ?
YES
NO
40
END OF LOOP
SET ERROR FLAG INDICATOR TO 1
A p.2
50
SET DISK DATA SET RECORD NUMBER WANTED
p.2

*OBTAINED FROM EPA WITHOUT DOCUMENTATION


p.2
MAGNETIC DISK
READ TABLES FOR THIS BLOCK
IS DIRECTION CONVERSION FROM EAST TO WEST ?
YES
70
SET VARIABLES
NO
60
SET VARIABLES
80
CALCULATE COORDINATES RELATIVE TO NEW UTM ZONE
CONVERT TO KILOMETERS
A
90
RETURN TO CALLING PROGRAM

```
C****PROGRAM NAME: CAASE1
C**** THIS PROGRAM IS DESIGNED TO EXTRACT ALL THE ENUMERATION DISTRICTS
C     FOR THE COUNTIES THAT BELONG TO THE SAME STUDY AREA.  IT THEN
C     WRITES AND EDITED MED-X TAPE FOR THIS AREA WHERE EACH RECORD
C     CONTAINS ALL THE INFORMATION FROM THE MED-X TAPE AND ALSO THE
C     ZONE NUMBER AND UTM COORDINATES.
C
C      THE USER CAN OPTIONALLY DEFINE PSEUDO ENUMERATION DISTRICTS FOR
C        GROWTH SINCE THE LAST GENERAL CENSUS AND CAN ALSO OPTIONALLY
C        DEFINE GENERAL AREAS OF GROWTH BY THE LOCATION COORDINATES OF
C        EACH RECTANGLE AND THE POPULATION COUNT AND HOUSING COUNT
C        COEFFICIENTS RESPECTIVELY.
C
C      SEE THE CAASE USER'S MANUAL (COMPUTER ASSISTED AREA SOURCE
C        GRIDDING PROCEDURE (CAASE) USER'S MANUAL, EPA-450/3-74-035
C        AS REVISED) FOR A COMPLETE DESCRIPTION OF INPUT, OUTPUT, AND
C        RUNNING INSTRUCTIONS.
C
C****  THESE DIMENSIONS ASSUME NO MORE THAN 30 COUNTIES FROM ANY ONE
C    STATE IN THE STUDY AREA, NO MORE THAN 100 PSEUDO (NEW) ENUMERATION
C    DISTRICTS IN THE STUDY AREA AND NO MORE THAN 100 RECTANGLES OF
C    GROWTH (POSITIVE OR NEGATIVE) IN THE STUDY AREA.
C
      DIMENSION XDATA(25),ICNTY(30),CNTY(5,30),AQCR(5),IREC(30),STATE(5)
     1,X(100),Y(100),XL(100),YL(100),JZON(100),HCOEF(100),PCOEF(100),
     2XRH(100),YTP(100),XX(100),YY(100),KZON(100),ISTAT(100),
     3KOUNTY(100),HCOUNT(100),PCOUNT(100)
      REAL*8 XLAT,XLONG,XXLAT,XXLONG,FMNOR,FMEAS
      REAL*8 DYOUT,DXOUT
C
C          ASSIGN READER UNIT NUMBER
      IREAD=1
C
C          ASSIGN PRINTER UNIT NUMBER
      IPRINT=3
C
C          ASSIGN MED-X TAPE UNIT NUMBER
```


SUBROUTINE YOFX
INITIALIZE Y
IS THIS SEGMENT VERTICAL
YES
RETURN TO CALLING PROGRAM
NO
CALCULATE THE INTERSECTION OF Y SEGMENT AND CELL SIDES
RETURN TO CALLING PROGRAM


SUBROUTINE XOFY
INITIALIZE X
IS THIS SEGMENT HORIZONTAL
YES
RETURN TO CALLING PROGRAM
NO
CALCULATE THE INTERSECTION OF X SEGMENT AND CELL SIDES
RETURN TO CALLING PROGRAM

```
      ITAP1=6
C
C          ASSIGN CAASE1 OUTPUT UNIT NUMBER
      ITAP2=4
      ICNT=1
      IND1=4
      REWIND ITAP2
C
C******READ INPUT CARD DATA, NUMBER OF STATES, STUDY AREA NAME, AND
C           PRIMARY UTM ZONE
C
C******CAUTION*********
C        STATES MUST BE REQUESTED IN THEIR ORDER ON THE MED-X TAPE
C        UNLESS USING DUALABS TAPES WHERE EACH STATE IS A SEPARATE FILE
C        IN WHICH CASE JCL WOULD CORRECTLEY POSITION EACH FILE , BUT
C        STATES BEING REQUESTED OUT OF ORDER WOULD BE INEFFICIENT.
C
      READ (IREAD,100) NSTAT,AQCR,KZONE
  100 FORMAT (I4,5A4,I4)
      WRITE (IPRINT,120) AQCR,NSTAT,KZONE
  120 FORMAT ('1STUDY AREA IS ',5A4/6X,'NO. OF STATES INCLUDED IS ',I4,1
     10X,' PRIMARY UTM ZONE IS ',I4///)
C
C*****READ IN PROJECTED FACTORS TO BE APPLIED TO ENUMERATION
C          DISTRICT POPULATION (RECTANGLES OF GROWTH)
C
      READ (IREAD,140) IGROTH,IEDS
  140 FORMAT (2I5)
C
C     IGROTH--GROWTH FACTORS?  YES=1, NO=0
      IF (IGROTH.EQ.0) GO TO 380
      WRITE (IPRINT,160)
  160 FORMAT (///' * * * * * * * * * UTM(KM) * * * * * * * *   UTM',13X,'**
     1COEFFICIENT ***'/5X,'X',9X,'Y',6X,'X LENGTH  Y LENGTH ZONE ',
     2'   HOUSING  POPULATION'//)
      DO 340 JJ=1,100
      READ (IREAD,180) X(JJ),Y(JJ),XL(JJ),YL(JJ),JZON(JJ),HCOEF(JJ),
     1PCOEF(JJ)
  180 FORMAT (4F10.0,I5,2F10.0)
C
C     LAST CARD TEST
      IF (X(JJ).NE.0.) GO TO 220
      IPROJ=JJ-1
      WRITE (IPRINT,200) IPROJ
  200 FORMAT ('0',' NUMBER OF RECTANGLES OF GROWTH = ',I4)
      GO TO 380
  220 WRITE(IPRINT,180)X(JJ),Y(JJ),XL(JJ),YL(JJ),JZON(JJ),HCOEF(JJ),
     1PCOEF(JJ)
C
C*****PLACE RECTANGLES OF GROWTH INTO PROPER ZONE
C
C     ALREADY PRIMARY ZONE ?
      IF (JZON(JJ).EQ.KZONE) GO TO 320

C     DETERMINE DIRECTION OF CONVERSION
      IF (JZON(JJ).GT.KZONE) GO TO 240
      EW=1.0
      GO TO 260
  240 EW=0.0
  260 IBAD=0
      DXOUT=X(JJ)
      DYOUT=Y(JJ)
      CALL GTGR(DYOUT,DXOUT,EW,IBAD)
      IF (IBAD.EQ.0) GO TO 300
      WRITE (IPRINT,280) Y(JJ),X(JJ)
  280 FORMAT (///,' ERROR IN PLACING RECTANGLE OF GROWTH INTO PROPER UTM
     1 ZONE, Y, X  = ',2F15.2)
      GO TO 1600
C
C     CALCULATE TOP RIGHT HAND CORNER OF RECTANGLE IN PRIMARY ZONE,
C        I.E., NEED ONLY MIN AND MAX X AND Y
C
  300 X(JJ)=DXOUT
      Y(JJ)=DYOUT
  320 XRH(JJ)=X(JJ)+XL(JJ)
      YIP(JJ)=Y(JJ)+YL(JJ)
  340 CONTINUE
      WRITE (IPRINT,360)
  360 FORMAT (//' RECTANGLES OF GROWTH EXCEEDED MAXIMUM STORAGE ALLOCATE
     1D')
      GO TO 1600
C
C*****READ IN COORDINATES AND POPULATION FOR PROJECTED ENUMERATION
C         DISTRICTS IF THERE ARE ANY
C
C      IEDS--PROJECTED ENUMERATION DISTRICTS (ED'S)?  YES=1, NO=0
  380 IF (IEDS.EQ.0) GO TO 520
      WRITE (IPRINT,400)
  400 FORMAT (//38X,'** COEFFICIENT **'/' UTM X(KM) UTM Y(KM) ZONE STATE
     1 CNTY  HOUSING POPULATION'//)
      DO 480 KK=1,100
      READ (IREAD,420) XX(KK),YY(KK),KZON(KK),ISTAT(KK),KOUNTY(KK),HCOUN
     1T(KK),PCOUNT(KK)
  420 FORMAT (2F10.0,3I5,2F10.0)
      IF (XX(KK).NE.0.) GO TO 460
      NEWEDS=KK-1
      WRITE (IPRINT,440) NEWEDS
  440 FORMAT ('0',' NUMBER OF NEW ENUMERATION DISTRICTS = ',I4)
      GO TO 520
  460 WRITE (IPRINT,420) XX(KK),YY(KK),KZON(KK),ISTAT(KK),KOUNTY(KK),HCO
     1UNT(KK),PCOUNT(KK)
  480 CONTINUE
      WRITE (IPRINT,500)
  500 FORMAT (//' NUMBER OF PSEUDO ENUMERATION DISTRICTS EXCEEDS MAXIMUM
     1 STORAGE ALLOCATED'//)
  520 CONTINUE
C
C      INITIALIZE FILE COUNTER
      IEND=0
C
C**** READ IN STATE NAME AND FIPS CODE AND NUMBER OF COUNTIES IN THE
```

```
C     STATE AND THEIR FIPS CODE NUMBERS AND NAMES
C
      READ (IREAD,100) NCNTY,STATE,KSTATE
      READ (IREAD,560) (ICNTY(N),(CNTY(M,N),M=1,5),N=1,NCNTY)
  560 FORMAT (I4,5A4)
      WRITE (IPRINT,580) (ICNTY(N),(CNTY(M,N),M=1,5),N=1,NCNTY)
  580 FORMAT ('0',10X,I4,5A4)
      WRITE (IPRINT,600) STATE,NCNTY
  600 FORMAT ('0',5X,'THE STATE OF ',5A4,' HAS ',I4,' COUNTY(S)')
C
C**** SET COUNTERS FOR NUMBER OF ENUMERATION DISTRICTS PROCESSED FOR
C     EACH COUNTY TO ZERO. (IREC)
C
      DO 620 K=1,NCNTY
      IREC(K)=0
  620 CONTINUE
C*****SET CONSTANTS.
      I=1
      IWHER=1
  640 CONTINUE
      MTCH=0
      WRITE (IPRINT,660) (CNTY(J,I),J=1,5)
  660 FORMAT (///,5X,'COUNTY ',5A4)
C
C     HAS THE FIRST RECORD OF A NEW COUNTY ALREADY BEEN READ WHILE
C       PROCESSING ANOTHER COUNTY ?
C
      GO TO (680,720),IWHER
C
C*****READ MED-X TAPE AND SELECT ALL ENUMERATION DISTRICTS THAT LIE IN
C     THE REQUIRED COUNTIES.
C
  680 READ (ITAP1,700,END=1420) LSTATE,XDATA(1),JCNTY,(XDATA(L),L=2,23),
     1XHOUS,XPOP,XLONG,XLAT
  700 FORMAT(I2,A2,I3,21A4,A2,F7.0,F8.0,2F10.4)
      IF(LSTATE.NE.KSTATE) GO TO 680
  720 IF (JCNTY-ICNTY(I))  680,740,1320
```

```
                                                                          159
C
C**** HAVE FOUND A COUNTY MATCH.                                          162
  740 IF (MTCH.EQ.1) GO TO 920                                            163
      MTCH=1                                                              164
C
C**** ADD NEW ENUMERATION DISTRICTS TO OUTPUT TAPE IF THERE ARE ANY
C        FOR THIS COUNTY                                                  166
C                                                                         167
      IF (IEDS.EQ.0) GO TO 920                                            168
      DO 900 L=1,NEWEDS
C
C     COUNTY MATCH ?                                                      169
      IF (KOUNTY(L)-JCNTY)  900,760,900
C
C       COORDINATES PRIMARY ZONE ?                                        170
  760 IF (KZON(L).EQ.KZONE) GO TO 860
C
C     DETERMINE DIRECTION OF CONVERSION                                   171
      IF (KZON(L).GT.KZONE) GO TO 780                                     172
      EW=1.0                                                              173
      GO TO 800                                                           174
  780 EW=0.0                                                              175
  800 IBAD=0                                                              176
      DXOUT=XX(L)                                                         177
      DYOUT=YY(L)                                                         178
      CALL GTGR(DYOUT,DXOUT,EW,IBAD)                                      179
      IF (IBAD.EQ.0) GO TO 840                                            180
      WRITE (IPRINT,820) YY(L),XX(L)
  820 FORMAT (///,' ERROR IN PLACING NEW ENUMERATION DISTRICT IN PROPER
     1UTM ZONE, Y, X = ',2F15.2)                                          183
      GO TO 1600                                                          184
  840 XX(L)=DXOUT                                                         185
      YY(L)=DYOUT                                                         186
  860 CONTINUE                                                            187
C
C***** WRITE GOOD PSEUDO ENUMERATION DISTRICT RECORD ON OUTPUT TAPE
C       WITH DUMMY LATITUDE AND LONGITUDE FOR RECORD PADDING
```

```
C
      XLONG=1.0E+10
      XLAT=1.0E+10
C
C******  SET CODE INDICATING PSEUDO ENUMERATION DISTRICT RECORD
C
      KODE=3
      WRITE(ITAP2,870) ISTAT(L),KOUNTY(L),HCOUNT(L),PCOUNT(L),XLONG,
     1XLAT,KZONE,XX(L),YY(L),KODE
  870 FORMAT(I2,2X,I4,86X,F7.0,F8.0,2D25.16,I5,2F15.2,I4)
      WRITE (IPRINT,880) ISTAT(L),KOUNTY(L),HCOUNT(L),PCOUNT(L),XLONG,XL
     1AT,KZONE,XX(L),YY(L),KODE
  880 FORMAT ('0',I2,3X,I3,86X,F7.0,F8.0,/,3X,2D25.16,I5,2F15.2,I4,//)
      IREC(I)=IREC(I)+1
  900 CONTINUE
C
C*** FINISHED WITH PSEUDO ED'S BEING ADDED.
C
C***** NOW PROCESS EXISTING ENUMERATION DISTRICTS, FIRST RECORD WAS
C       ALREADY READ AT STATEMENT 680
C
C     NOW FIND THE UTM COORDINATES FOR THIS DISTRICT AND ADD TO
C      AN OUTPUT TAPE.
C
C      IF LATITUDE AND LONGITUDE ARE ZERO, THEN  THE RECORD IS A
C      SUMMARY RECORD, DON'T PROCESS IT.
  920 IF (XLONG+XLAT.EQ.0.) GO TO 680
      XXLAT=XLAT*3.6D8
C
C     CONVERT COORDINATES OF LATITUDE AND LONGITUDE TO UTM
C**** FOR CED009, WEST LONGITUDES ARE NEGATIVE, WE ARE ALWAYS DEALING
C     WITH WEST.
      XXLONG=-XLONG*3.6D8
      CALL CED009(XXLONG,XXLAT,IND1,MZON,FMNOR,FMEAS,MERR)
C     ANY NON-ZERO ERROR CODES RETURNED FROM CED009?
      IF (MERR)  940,1080,940
  940 GO TO (960,1000,1040),MERR
```

```
 960 WRITE (IPRINT,980) IND1
 980 FORMAT (3X,'CALLED CED009 WITH IND1 GT 4 OR IND1 LT 0, IND1= ',I3)
    1
     GO TO 1600
1000 WRITE (IPRINT,1020) XLAT
1020 FORMAT (3X,'LAT EXCEEDS 80 DEG, LAT= ',D25.16)
     GO TO 1600
1040 WRITE (IPRINT,1060) XLONG
1060 FORMAT (3X,'ABS(LONG) GT 180 DEG, LONG= ',D25.16)
     GO TO 1600
C
C   CONVERT METERS TO KILOMETERS
C
1080 XOUT=FMEAS/1000.
     YOUT=FMNOR/1000.
C
C*****IS THIS DISTRICT LOCATED IN THE PRIMARY UTM ZONE
C
     IF (MZON.EQ.KZONE) GO TO 1180
C
C   NEED TO CONVERT TO PRIMARY ZONE, DETERMINE EAST-WEST DIRECTION OF
C   CONVERSION
     IF (MZON.GT.KZONE) GO TO 1100
     EW=1.0
     GO TO 1120
1100 EW=0.0
1120 IBAD=0
     DYOUT=YOUT
     DXOUT=XOUT
     CALL GTGR(DYOUT,DXOUT,EW,IBAD)
     IF (IBAD.EQ.0) GO TO 1160
     WRITE (IPRINT,1140) YOUT,XOUT
1140 FORMAT (///,' ERROR IN CONVERTING COORDINATES TO PRIMARY UTM ZONE,
    1 Y, X = ',2F15.2)
     GO TO 1600
1160 CONTINUE
     XOUT=DXOUT
```

```
      YOUT=DYOUT
C
C***** ARE THERE PROJECTED FACTORS FOR THIS ED, I.E., IS IT WITHIN A
C     RECTANGLE OF GROWTH.
C      (CHECK RECTANGLES OF GROWTH)
C
C     ANY RECTANGLES TO CHECK ?
 1180 IF (IGROTH.EQ.0) GO TO 1240
      DO 1220 M=1,IPROJ
C
C     CHECK RECTANGLE SIDES
 1200 IF (X(M).GT.XOUT.OR.XRH(M).LT.XOUT) GO TO 1220
      IF (Y(M).GT.YOUT.OR.YTP(M).LT.YOUT) GO TO 1220
C
C     APPLY COEFFICIENTS
      XHOUS=XHOUS*HCOEF(M)
      XPOP=XPOP*PCOEF(M)
C
C     SET RECORD TYPE CODE TO INDICATE MODIFICATION MADE TO RECORD
      KODE=2
      GO TO 1260
 1220 CONTINUE
C
C     NO HOUSING OR POPULATION MODIFICATION  SET RECORD TYPE.
 1240 KODE=1
 1260 CONTINUE
C
C*****WRITE GOOD RECORD ON OUTPUT TAPE.
C
      WRITE (ITAP2,1280) LSTATE, XDATA(1),JCNTY,(XDATA(L),L=2,23),XHOUS,
     1XPOP,XLONG,XLAT,KZONE,XOUT,YOUT,KODE
 1280 FORMAT(I2,A2,I4,21A4,A2,F7.0,F8.0,2D25.16,I5,2F15.2,I4)
C
C***** THIS SECTION PRINTS THE FIRST 25 RECORDS (INCLUDING THE ADDED
C     ENUMERATION DISTRICTS) FOR EACH COUNTY.
C     CAN BE DELETED OR MODIFIED TO PRINT ALL RECORDS IF DESIRED.
C
```

```
      IREC(I)=IREC(I)+1
      IF (IREC(I).GT.25) GO TO 680
      WRITE(IPRINT,1300)LSTATE,XDATA(1),JCNTY,(XDATA(L),L=2,23),XHOUS,
     1XPOP,XLONG,XLAT,KZONE,XOUT,YOUT,KODE
 1300 FORMAT('0',1X,I2,A2,I3,21A4,A2,F7.0,F8.0,/,3X,2D25.16,I5,2F15.2,
     1I4,//)
      GO TO 680
C
C*****HAVE FOUND ALL ENUMERATIONS DISTRICTS FOR ONE COUNTY, LOOK FOR
C     ANOTHER COUNTY.
C
 1320 CONTINUE
      WRITE (IPRINT,1360) (CNTY(J,I),J=1,5),KZONE
 1360 FORMAT ('0',5X,'FOR COUNTY ',5A4,5X,'  ZONE NO.',I10//)
C
C*****TIME TO BEGIN A NEW COUNTY, IF THERE IS ONE.
      IF (IEND.EQ.1) GO TO 1460
      I=I+1
      IF (I-NCNTY)  1400,1400,1460
 1400 IWHER=2
      GO TO 640
C
C*****HAVE REACHED AN EOF ON THE INPUT FILE--SO, A STATE HAS BEEN ENDED.
 1420 IEND=1
      WRITE (IPRINT,1440)
 1440 FORMAT ('0','  HIT END OF FILE ON TAPE')
      GO TO 1320
 1460 WRITE (IPRINT,1480) STATE
 1480 FORMAT (//,5X,'THE STATE OF ',5A4,':',/,10X,'COUNTY NAME',19X,'COD
     1E NO.',10X,'NO. OF RECORDS WRITTEN ON TAPE')
      DO 1520 K=1,NCNTY
      WRITE (IPRINT,1500) (CNTY(J,K),J=1,5),ICNTY(K),IREC(K)
 1500 FORMAT ('0',10X,5A4,10X,I4,14X,I4)
 1520 CONTINUE
C
C***** IS THERE ANOTHER STATE IN THIS STUDY AREA?
      ICNT=ICNT+1
      IF(NSTAT-ICNT) 1560,520,520
C
C*****ALL DESIRED RECORDS HAVE BEEN WRITTEN.
 1560 WRITE (IPRINT,1580)
 1580 FORMAT (///,3X,'GOOD FINISH')
 1600 REWIND ITAP1
      ENDFILE ITAP2
      REWIND ITAP2
      CALL EXIT
      END
      SUBROUTINE CED009(XLNG,XLAT,IND1,      MZON,FMNOR,FMEAS,MERR)
C     MODIFIED BY HAWS, RTI, 12/72 FOR ONLY 1 SPHEROID,I.E. WHERE IND2=2
C     GEODETIC POSITION TO UNIVERSAL TRANSVERSE MERCATOR COORDINATES
C     DECH/COMPUTER CONCEPTS
      COMMON/CORD/COORD
      REAL*8 COORD(16,7)  ,FMPHI,FDELTA
      REAL*8 DELTA,ALPHA,DELTAQ,DELTAL,BETA
      REAL*8 GAMMA,DDELTA,FTERM
      REAL*8  FIMLAT,FIMLNG,FILNG,FILAT,FMN,FMEAS
      REAL*8 FMNOR,FMEAS,XLNG,XLAT
      MERR=0
      IF(IND1)1,1,2
    1 MERR=1
      RETURN
    2 IF(IND1-5)3,1,1
    3 GO TO (5,6,7,8),IND1
    5 FILNG=XLNG*78683.7792D0
      FILAT=XLAT*78683.7792D0
      GO TO 13
    6 FILNG=XLNG *.3814697265600
      FILAT=XLAT *.3814697265600
      GO TO 13
    7 FILNG=XLNG*2.062648062D0
      FILAT=XLAT*2.062648062D0
      GO TO 13
    8 FILNG = XLNG
      FILAT = XLAT
   13 IF(FILAT)14,15,15
   14 FIMLAT=-FILAT
      GO TO 16
   15 FIMLAT=FILAT
   16 CONTINUE
      IF(FIMLAT-2.88D10) 18,18,17
   17 MERR=2
      RETURN
   18 IF(FILNG)19,20,20
   19 FIMLNG=-FILNG
```

```
      GO TO 21
   20 FIMLNG=FILNG
   21 CONTINUE
      IF(FIMLNG-6.48D10) 24,23,22
   22 MERR=3
      RETURN
   23 MZON=1
      GO TO 25
   24 MZON = (FILNG+6.696D10)/2.16D9
   25 CONTINUE
  600 CONTINUE
      IF(FIMLAT-72.D8) 201,202,601
  601 CONTINUE
      IF(FIMLAT-144.D8) 202,203,602
  602 CONTINUE
      IF(FIMLAT-198.D8) 203,204,603
  603 CONTINUE
      IF(FIMLAT-234.D8) 204,205,604
  604 CONTINUE
      IF(FIMLAT-262.8D8) 205,206,605
  605 CONTINUE
      IF(FIMLAT-277.2D8) 206,207,207
  201 J=1
      FMPHI = 360.D7
      GO TO 210
  202 J=2
      FMPHI = 108.D8
      GO TO 210
  203 J=3
      FMPHI = 180.D8
      GO TO 210
  204 J=4
      FMPHI = 216.D8
      GO TO 210
  205 J=5
      FMPHI = 252.D8
      GO TO 210
```

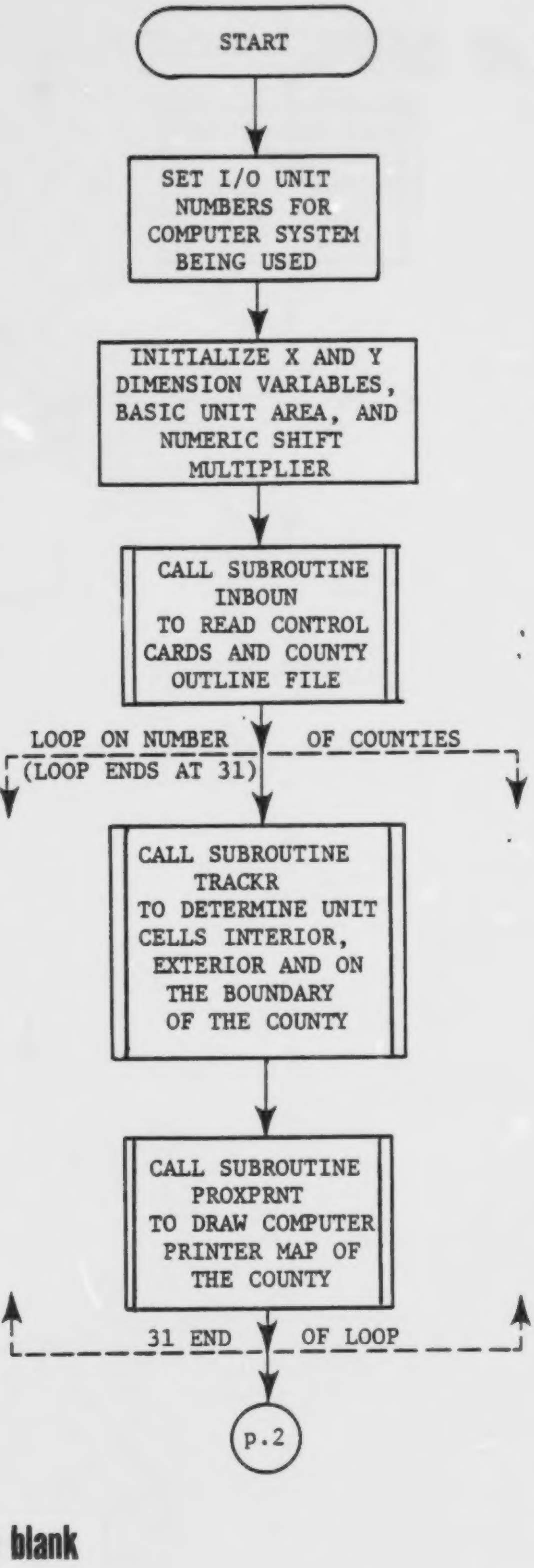
```
 206 J=6
     FMPHI = 270.D8
     GO TO 210
 207 J=7
     FMPHI = 282.6D8
 210 DELTA = (FIMLAT-FMPHI)*.00001D0
     I=6
     ALPHA=COORD(7,J)  +COORD(8,J)  *DELTA
 211 ALPHA=COORD(I,J)  +ALPHA*DELTA
     I=I-1
     IF(I)213,213,211
 213 DELTAQ=DELTA*ALPHA
     FTERM = MZON-31
     DELTAL=(216.D7* FTERM   +108.D7)-FILNG
     DELTAL=DELTAL*4848136811.D-20
     ALPHA=COORD(15,J)  +COORD(16,J)  *DELTAQ
     BETA=COORD(16,J)  *DELTAL
     I=14
 215 GAMMA=COORD(I,J)  +ALPHA*DELTAQ-BETA*DELTAL
     DDELTA=ALPHA*DELTAL+BETA*DELTAQ
     ALPHA=COORD(I-1,J)  +GAMMA*DELTAQ-DDELTA*DELTAL
     BETA=GAMMA*DELTAL+DDELTA*DELTAQ
     I=I-2
     IF(I-10)220,220,215
 220 GAMMA=COORD(10,J)  +ALPHA*DELTAQ-DELTAL*BETA
     DDELTA=ALPHA*DELTAL+BETA*DELTAQ
     FMN = COORD(9,J)  +GAMMA*DELTAQ-DDELTA*DELTAL
     FMEAS = 5.0D5 -(GAMMA*DELTAL+DDELTA*DELTAQ)
5000 FORMAT(2D25.16)
     IF(XLAT)225,224,224
 225 FMNOR = 1.0D7-FMN
     GO TO 227
 224 FMNOR = FMN
 227 RETURN
     END
```

```
      BLOCK DATA
      COMMON / CORD/COORD
      REAL*8 COORD(16,7)
      REAL*8 CORD12(16),CORD22(16),CORD32(16),CORD42(16),CORD52(16),
     1    CORD62(16),CORD72(16)
      EQUIVALENCE
     1    (COORD(1,1)  , CORD12(1)) ,(COORD(1,2)  ,CORD22(1)),
     2    (COORD(1,3)  , CORD32(1)) ,(COORD(1,4)  ,CORD42(1)),
     3    (COORD(1,5)  , CORD52(1)) ,(COORD(1,6)  ,CORD62(1)),
     4    (COORD(1,7)  , CORD72(1))
       DATA CORD12/ .4890603699E-05, .0211783470E-10,
     1.0206094087E-15, .0021352799E-20, .0013344641E-25,
     2.0002154192E-30, .0001051211E-35, .0000219788E-40,
     31105343.100,.6279435439E 07, -.0545206260E 07, -.0990165054E 07,
     4  .0221578063E 07, .0222595275E 07, -.0066799370E 07,
     5-.0054352765E 07/
       DATA CORD22/ .5569679060E-05, .0787424577E-10,
     1.0366618535E-15, .0107351529E-20, .0043800764E-25,
     2.0016151478E-30, .0006562645E-35, .0002627691E-40,
     33518605.326,.5526156860E 07, -.1381539215E 07, -.0464043656E 07,
     4  .0406929868E 07, -.0023737423E 07, -.0091961450E 07,
     5.0037826746E 07/
       DATA CORD32/ .7521184517E-05, .2184990662E-10,
     1.1135593294E-15, .0576965638E-20, .0323544317E-25,
     2.0186820832E-30, .0111283189E-35, .0067606710E-40,
     35538411.779,.4106355473E 07, -.1572825396E 07, .0118047314E 07,
     4 .0195232064E 07, -.0109480462E 07, .0014859044E 07,
     5.0015131135E 07/
       DATA CORD42/ .9679783520E-05, .4077989432E-10,
     1.2659560366E-15, .1833896462E-20, .1361507835E-25,
     2.1050208779E-30, .0833567868E-35, .0675334139E-40,
     36651204.6,.3195949863E 07, -.1383886879E 07, .0266102296E 07,
     4.0058104357E 07, -.0067036894E 07, .0025282671E 07,
     5-.0002169360E 07/
       DATA CORD52/ 1.4163711960E-05, .9448163773E-10,
     1 .8939144732E-15, .9299525223E-20, 1.0336559489E-25,
     21.1963321013E-30, 1.4242120367E-35, 1.7308124042E-40,
37765697.7,.2187148430E 07, -.1027623620E 07, .0279208157E 07,
4-.0025458841E 07, -.0018513695E 07 , .0012562355E 07,
5-.0004359447E 07/
 DATA CORD62/ 1.8723215513E-05, 1.6953882434E-10,
1 2.1175151210E-15, 2.9398158655E-20, 4.3557493117E-25,
26.7218060066E-30, 10.6695415012E-35, 17.2886054901E-40,
38323452.6,.1655376293E 07, -.0799485147E 07, .0238924408E 07,
4-.0039827738E 07, -.0003223536E 07, .0005528952E 07,
5-.0002522388E 07/
 DATA CORD72/ 2.4310955817E-05, 2.8981418519E-10,
1 4.6980991563E-15, 8.5098855196E-20, 16.4479412680E-25,
233.1014282702E-30, 68.5329893109E-35, 144.8462561026E-40,
3 8714033.1,.1275252086E 07, -.0624825325E 07, .0195643581E 07,
4-.0039646076E 07, .0002575786E 07, .0002080265E 07,
5-.0001257142E 07/
 END
```

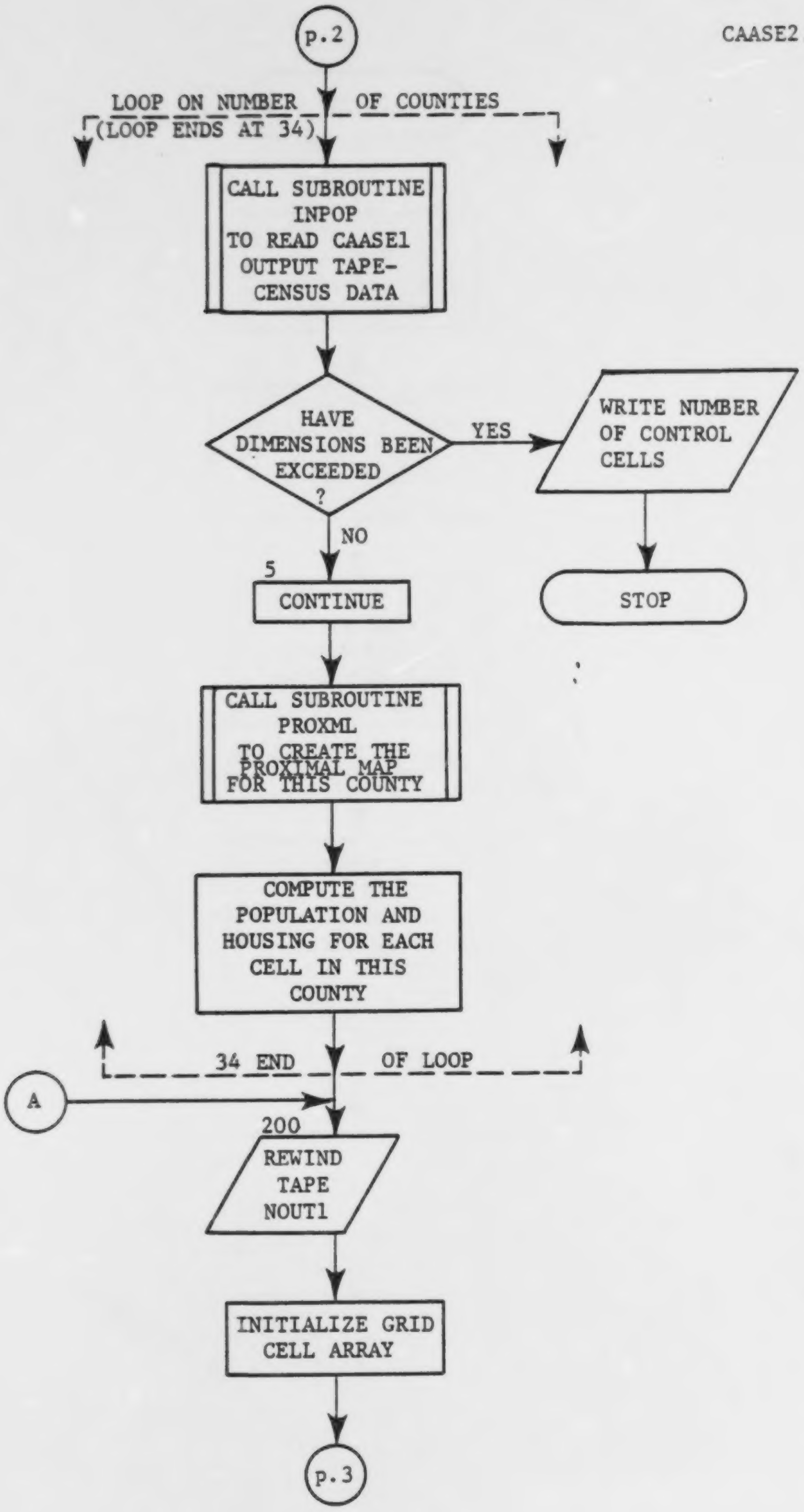
```
      SUBROUTINE GTGR (CN,CE,EW,IBAD)
C*****THIS PROGRAM CONVERTS POINTS FROM ONE ZONE INTO ANOTHER ZONE.
C     IT REQUIRES Y,X COORDINATES.
C     NEEDS EW=0 GOING FROM EAST TO WEST. EW=1 GOING FROM WEST TO EAST.
C     IBAD=1 INDICATES AN ERROR.
      DIMENSION B1(8,8),NR(61)                                          00000020
      REAL*8 B1,A1,RN,RE,CNP,CEP,A,B,C,D,CN,CE,V1                       00000030
      DEFINE FILE 5(61,512,L,IJK)                                       00000040
      DATA NR/20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38, 00000050
     1        39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57, 00000060
     2        58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76, 00000070
     3        77,78,79,80/                                              00000080
      CN = CN*1000.0                                                    00000090
      CE = CE*1000.0                                                    00000100
      A1 = CN/100000.0                                                  00000110
      IN = A1 + .5                                                      00000120
      RN = IN * 100000                                                  00000130
      A1 = CE/100000.0                                                  00000140
      IE = A1 + .5                                                      00000150
      RE = IE * 100000                                                  00000160
      CNP = (CN-RN)*.00001                                              00000170
      CEP = (CE-RE)*.00001                                              00000180
      DO 40 I=1,61                                                      00000190
      IF (NR(I).EQ.IN) GO TO 50                                         00000200
   40 CONTINUE                                                          00000210
      IBAD=1
      GO TO 90
   50 IBLOCK = I                                                        00000220
      READ(5'IBLOCK) B1
      IF (EW.EQ.1.) GO TO 60
      IF (EW.EQ.0.) GO TO 70
   60 IE = 10 - IE                                                      00000260
      GO TO 80                                                          00000270
   70 V1 = -1.0                                                         00000280
      B1(IE,2) = B1(IE,2) * V1                                          00000290
      B1(IE,4) = B1(IE,4) * V1                                          00000300
      B1(IE,6) = B1(IE,6) * V1                                          00000310
   B1(IE,8) = B1(IE,8) * V1                                           00000320
80 A =(B1(IE,5)+((CNP*B1(IE,7))-(CEP*B1(IE,8))))                      00000330
   B =(B1(IE,6)+((CNP*B1(IE,8))+(CEP*B1(IE,7))))                      00000340
   C =(B1(IE,3)+((CNP*A)-(CEP*B)))                                    00000350
   D =(B1(IE,4)+((CNP*B)+(CEP*A)))                                    00000360
   CN =(B1(IE,1)+((CNP*C)-(CEP*D)))                                   00000370
   CE =(500000.0+B1(IE,2)+((CNP*D)+(CEP*C)))                          00000380
   CN = CN/1000.0                                                     00000390
   CE = CE/1000.0                                                     00000400
90 RETURN
   END                                                                00000420
```

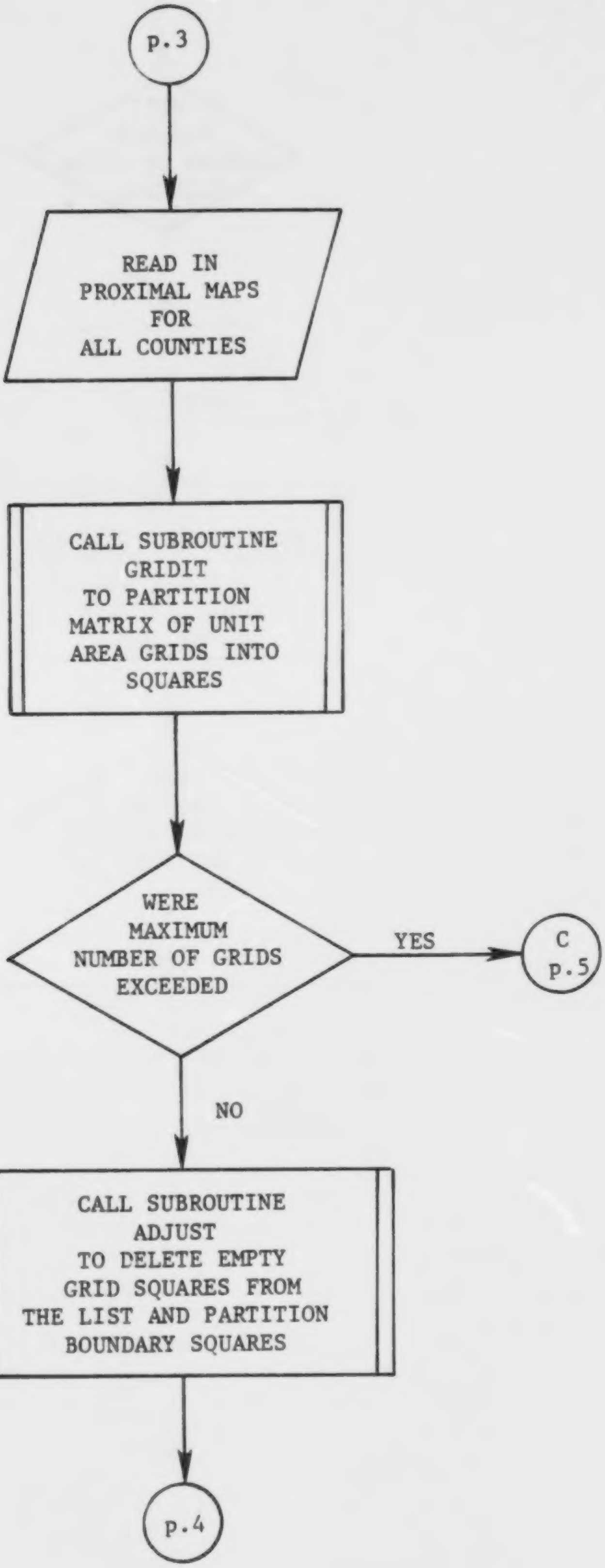
APPENDIX B

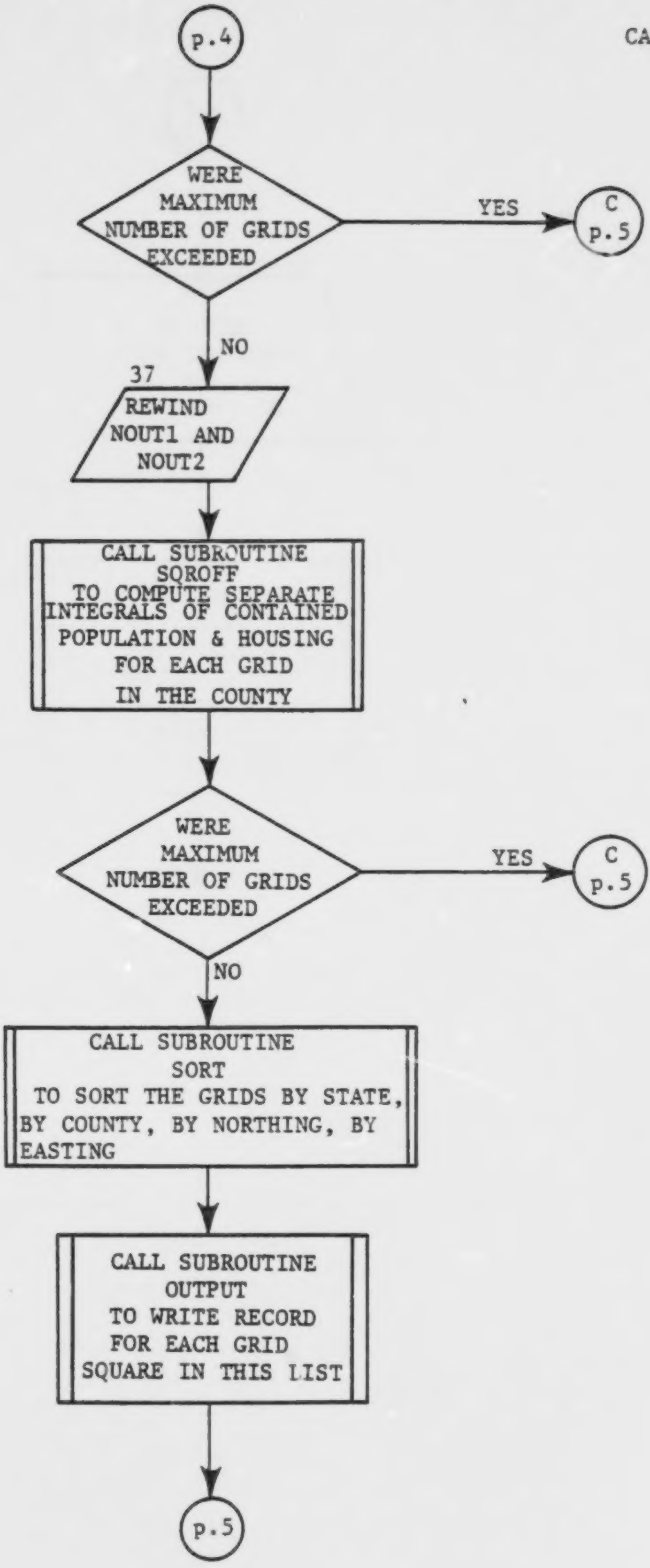
LOGICAL FLOWCHARTS AND FORTRAN SOURCE CODE LISTINGS
CAASE2 (and Subroutines)

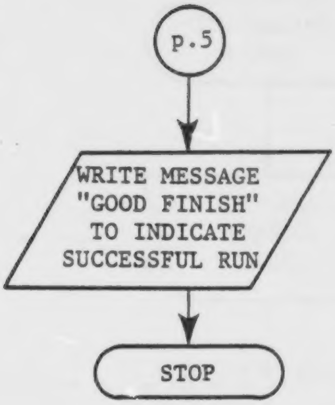

START
SET I/O UNIT NUMBERS FOR COMPUTER SYSTEM BEING USED
INITIALIZE X AND Y DIMENSION VARIABLES, BASIC UNIT AREA, AND NUMERIC SHIFT MULTIPLIER
CALL SUBROUTINE INBOUN TO READ CONTROL CARDS AND COUNTY OUTLINE FILE
LOOP ON NUMBER OF COUNTIES
(LOOP ENDS AT 31)
CALL SUBROUTINE TRACKR TO DETERMINE UNIT CELLS INTERIOR, EXTERIOR AND ON THE BOUNDARY OF THE COUNTY
CALL SUBROUTINE PROXPRNT TO DRAW COMPUTER PRINTER MAP OF THE COUNTY
31 END OF LOOP
p.2

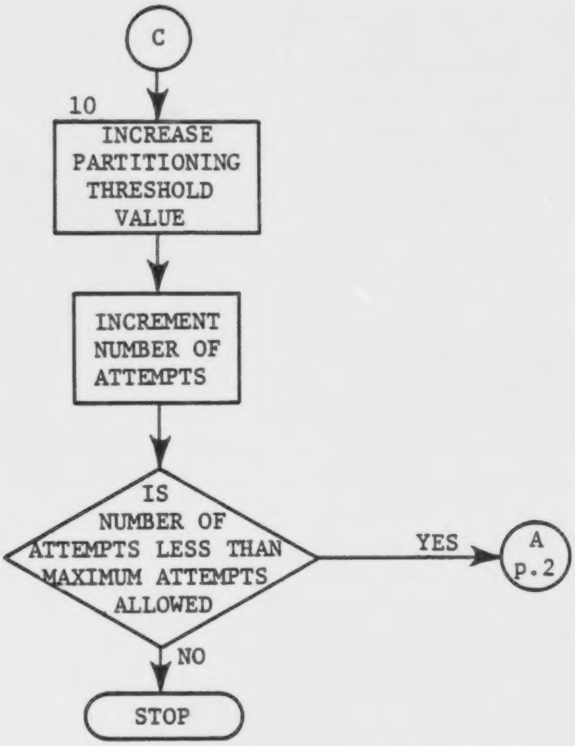
Preceding page blank


p.2
LOOP ON NUMBER OF COUNTIES
(LOOP ENDS AT 34)
CALL SUBROUTINE INPOP TO READ CAASE1 OUTPUT TAPE-CENSUS DATA
HAVE DIMENSIONS BEEN EXCEEDED ?
YES
WRITE NUMBER OF CONTROL CELLS
STOP
NO
5
CONTINUE
CALL SUBROUTINE PROXML TO CREATE THE PROXIMAL MAP FOR THIS COUNTY
COMPUTE THE POPULATION AND HOUSING FOR EACH CELL IN THIS COUNTY
34 END OF LOOP
A
200
REWIND TAPE NOUT1
INITIALIZE GRID CELL ARRAY
p.3

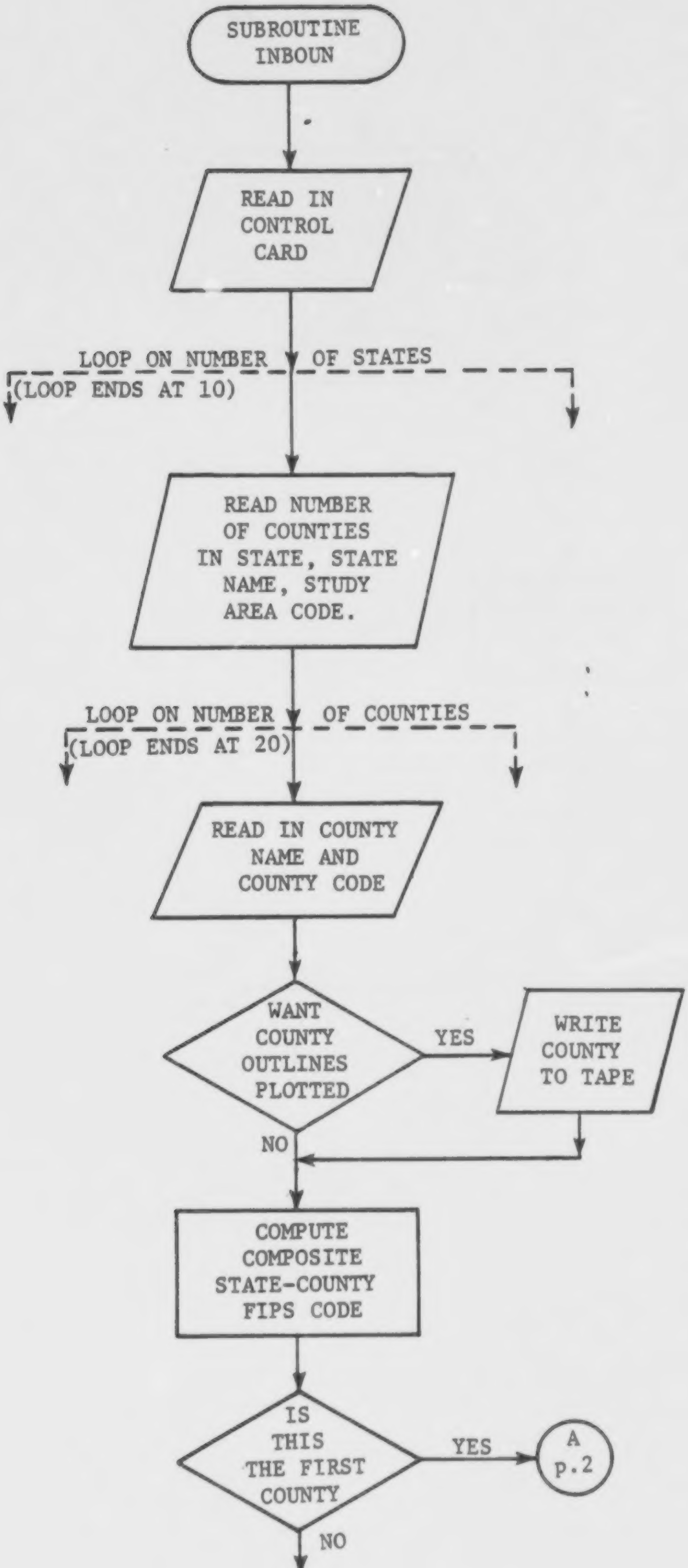

p.3
READ IN PROXIMAL MAPS FOR ALL COUNTIES
CALL SUBROUTINE GRIDIT TO PARTITION MATRIX OF UNIT AREA GRIDS INTO SQUARES
WERE MAXIMUM NUMBER OF GRIDS EXCEEDED
YES
C p.5
NO
CALL SUBROUTINE ADJUST TO DELETE EMPTY GRID SQUARES FROM THE LIST AND PARTITION BOUNDARY SQUARES
p.4


p.4
WERE MAXIMUM NUMBER OF GRIDS EXCEEDED
YES
C p.5
NO
37
REWIND NOUT1 AND NOUT2
CALL SUBROUTINE SQROFF TO COMPUTE SEPARATE INTEGRALS OF CONTAINED POPULATION & HOUSING FOR EACH GRID IN THE COUNTY
WERE MAXIMUM NUMBER OF GRIDS EXCEEDED
YES
C p.5
NO
CALL SUBROUTINE SORT TO SORT THE GRIDS BY STATE, BY COUNTY, BY NORTHING, BY EASTING
CALL SUBROUTINE OUTPUT TO WRITE RECORD FOR EACH GRID SQUARE IN THIS LIST
p.5

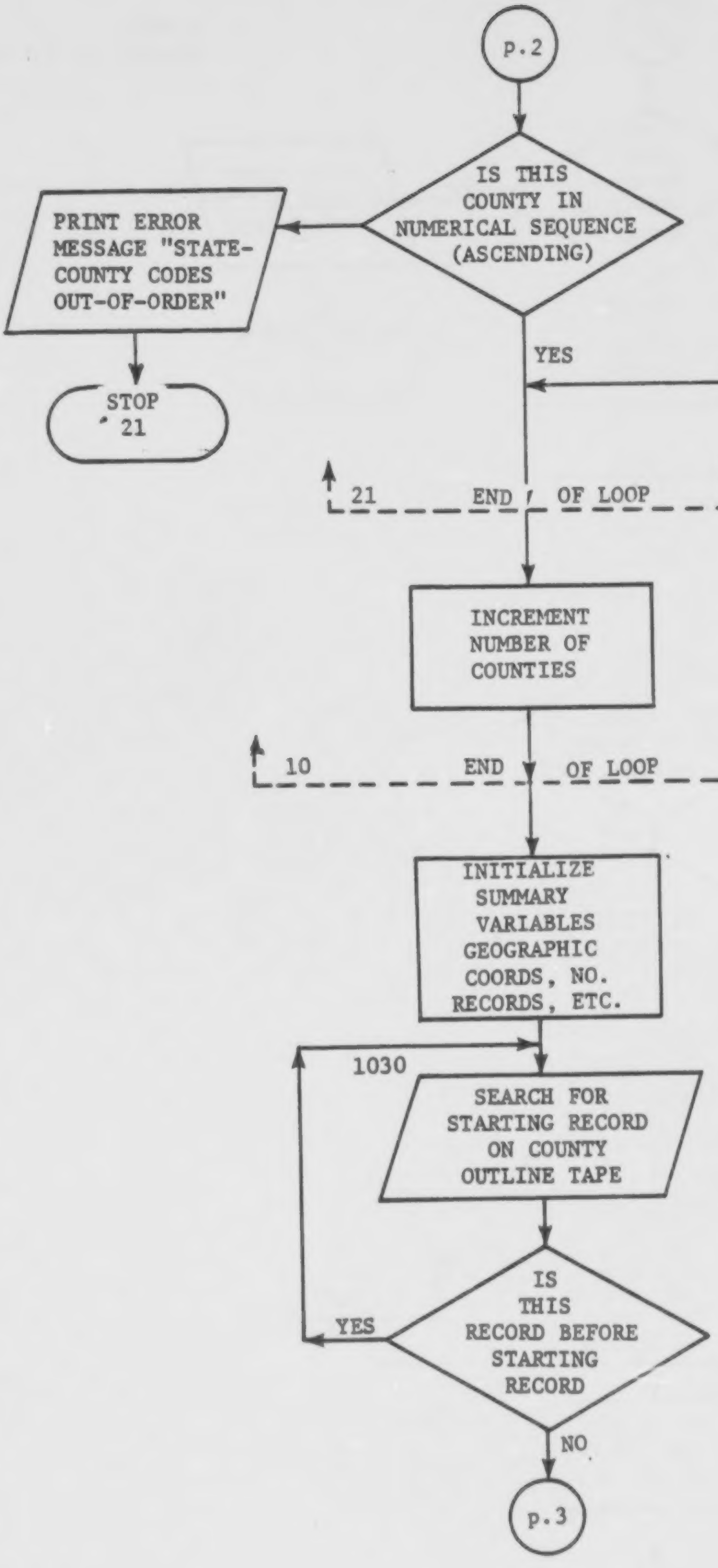

p.5
WRITE MESSAGE "GOOD FINISH" TO INDICATE SUCCESSFUL RUN
STOP

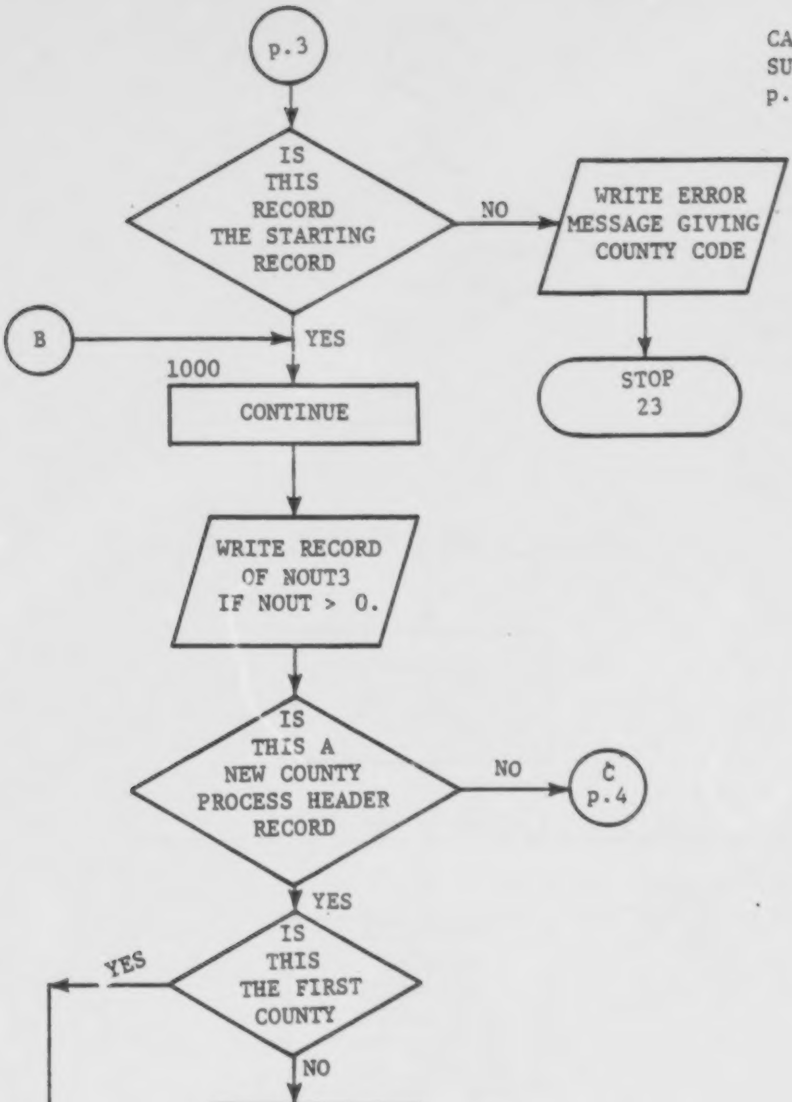

C
10
INCREASE PARTITIONING THRESHOLD VALUE
INCREMENT NUMBER OF ATTEMPTS
IS NUMBER OF ATTEMPTS LESS THAN MAXIMUM ATTEMPTS ALLOWED
YES
A p.2
NO
STOP

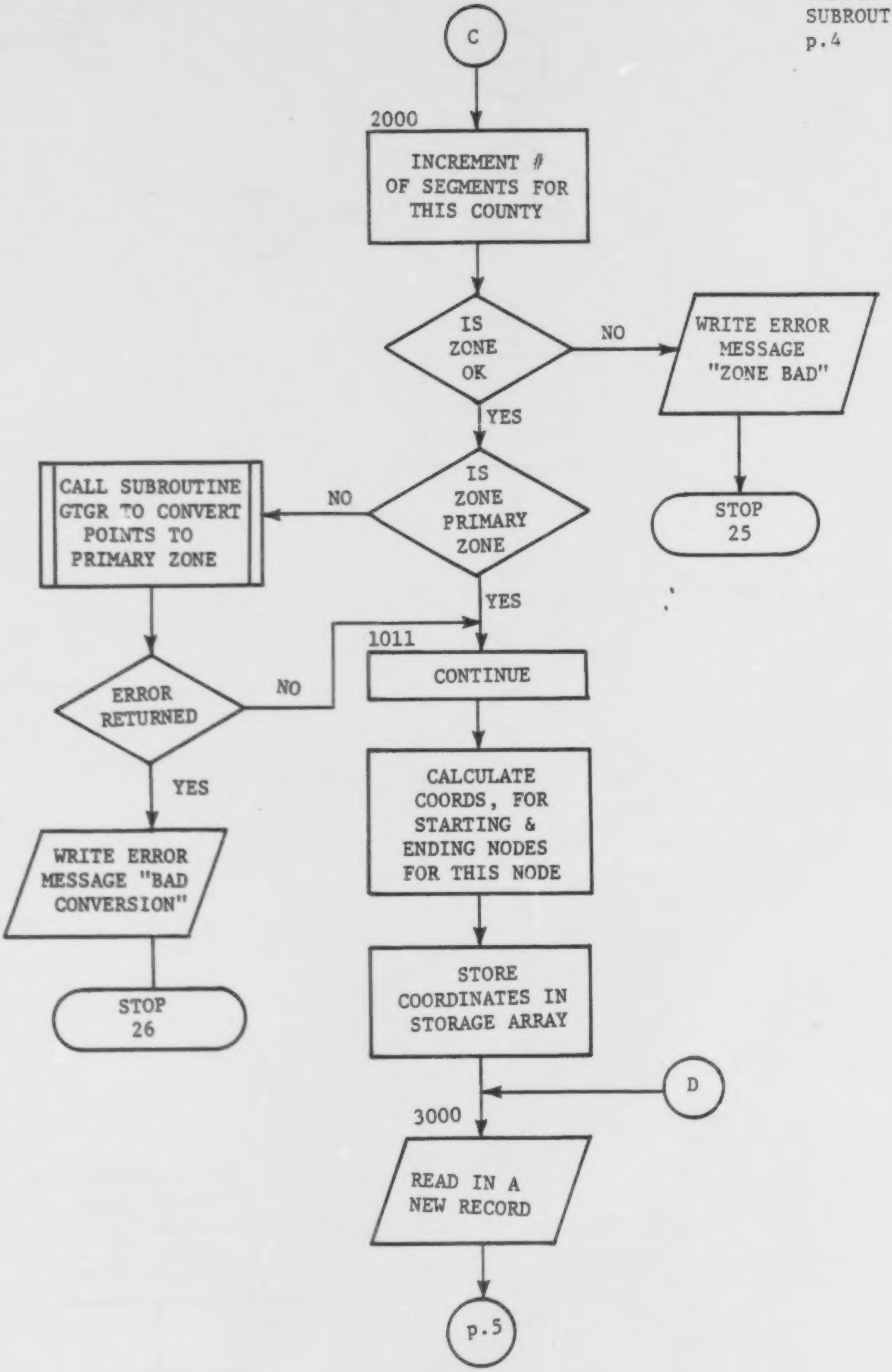
CAASE2
SUBROUTINE INBOUN

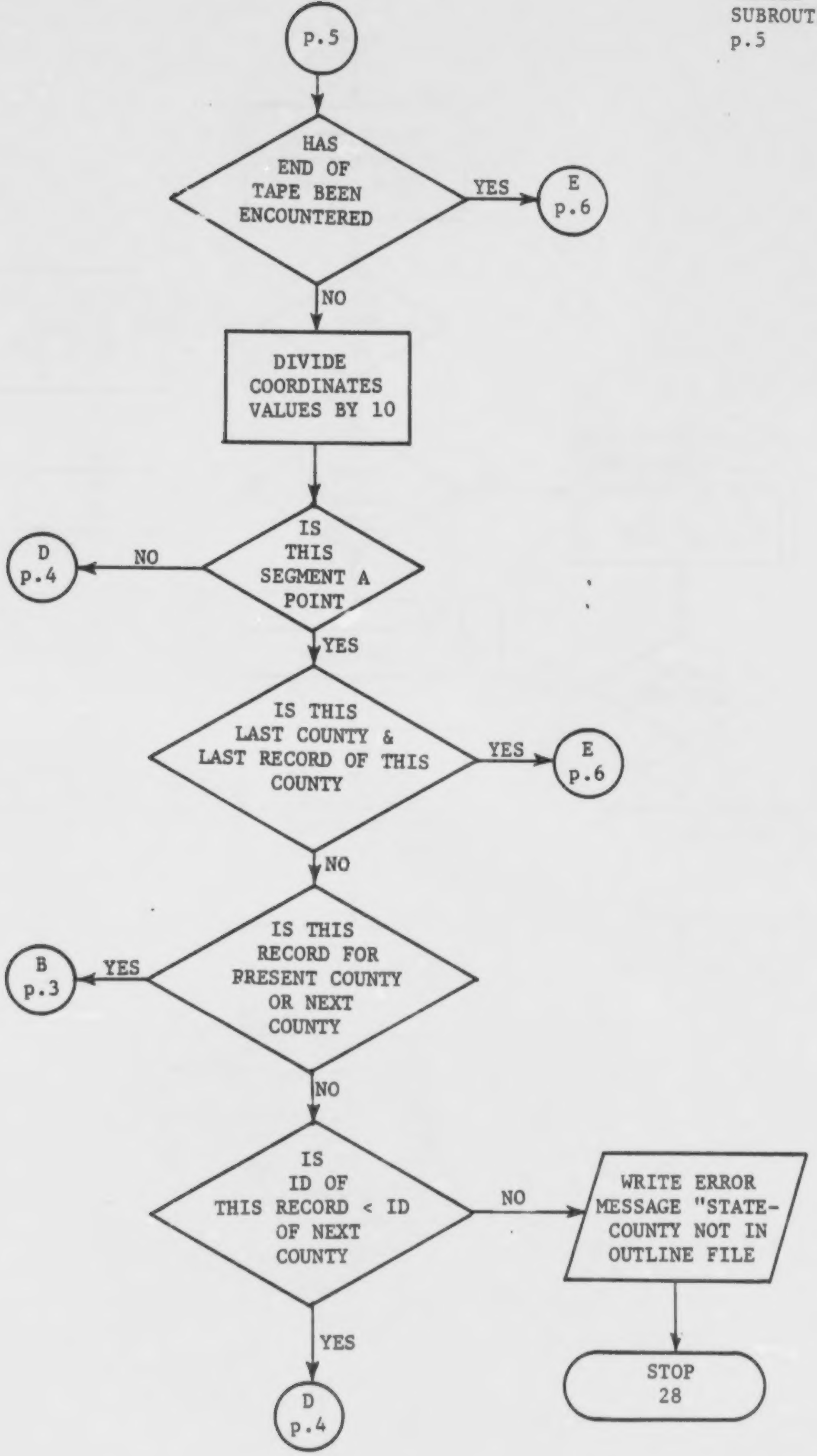


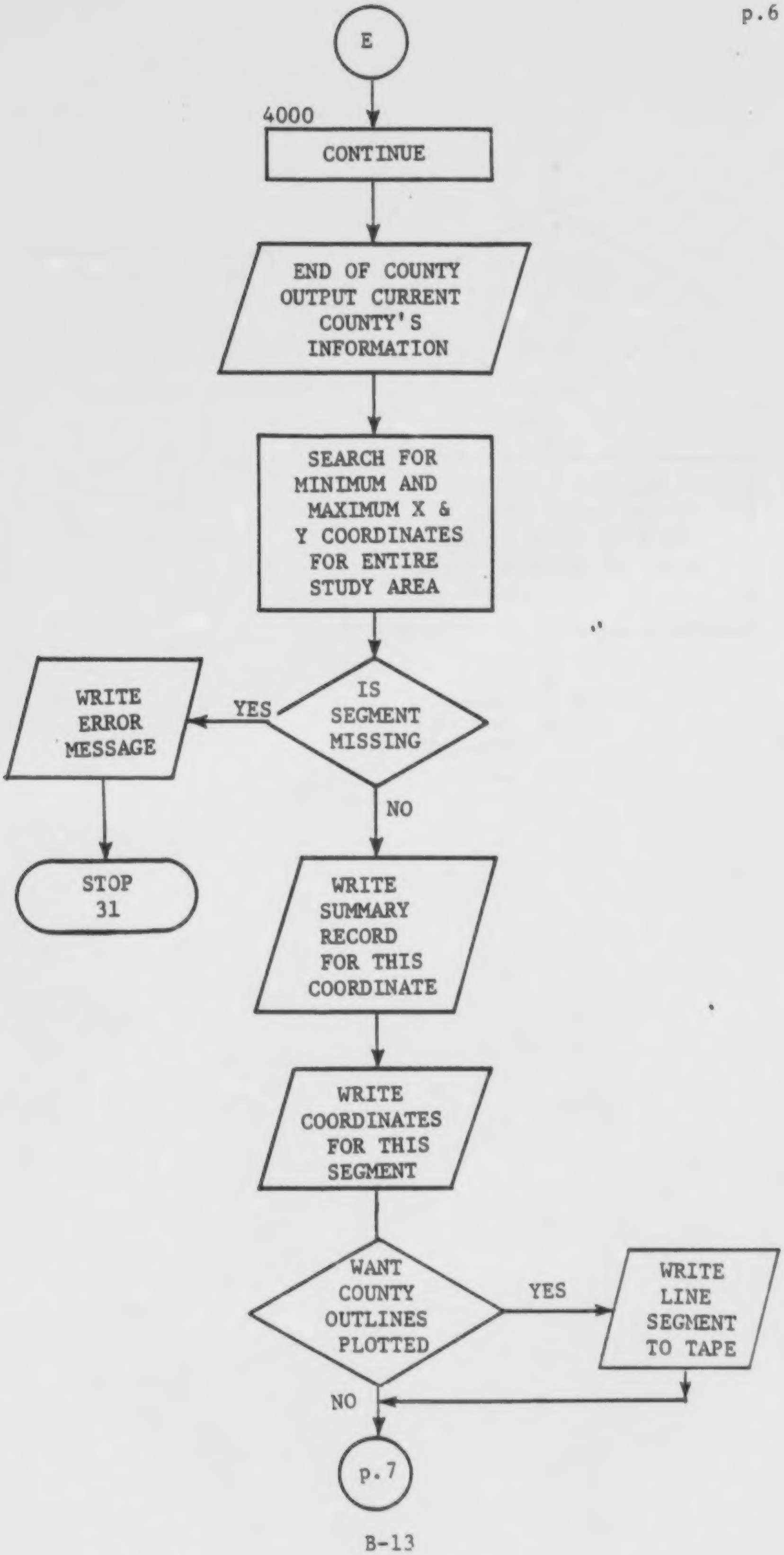
SUBROUTINE INBOUN
READ IN CONTROL CARD
LOOP ON NUMBER OF STATES
(LOOP ENDS AT 10)
READ NUMBER OF COUNTIES IN STATE, STATE NAME, STUDY AREA CODE.
LOOP ON NUMBER OF COUNTIES
(LOOP ENDS AT 20)
READ IN COUNTY NAME AND COUNTY CODE
WANT COUNTY OUTLINES PLOTTED
YES
WRITE COUNTY TO TAPE
NO
COMPUTE COMPOSITE STATE-COUNTY FIPS CODE
IS THIS THE FIRST COUNTY
YES
A p.2
NO
p.2

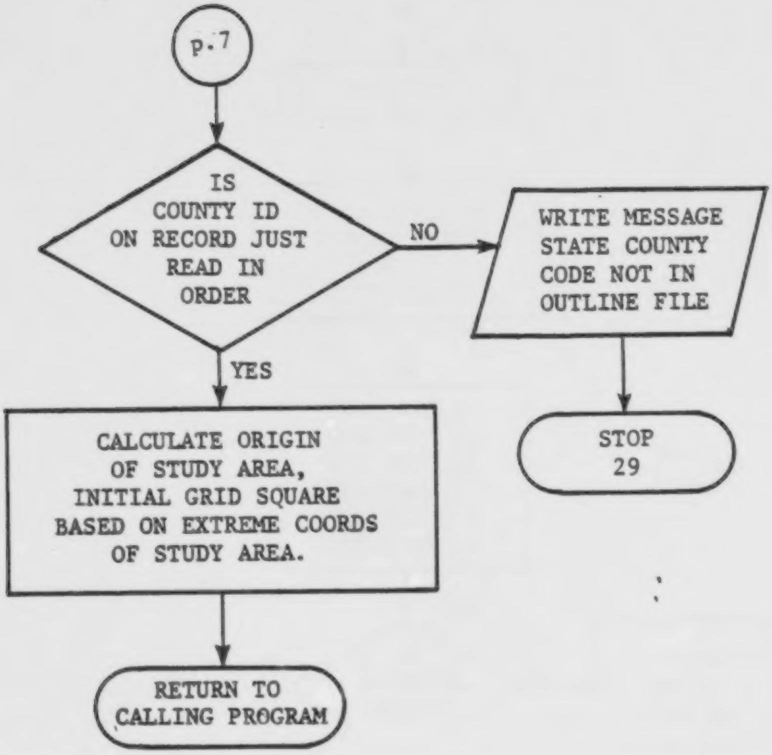

p.2
IS THIS COUNTY IN NUMERICAL SEQUENCE (ASCENDING)
PRINT ERROR MESSAGE "STATE-COUNTY CODES OUT-OF-ORDER"
STOP 21
YES
A
21 END OF LOOP
INCREMENT NUMBER OF COUNTIES
10 END OF LOOP
INITIALIZE SUMMARY VARIABLES GEOGRAPHIC COORDS, NO. RECORDS, ETC.
1030
SEARCH FOR STARTING RECORD ON COUNTY OUTLINE TAPE
IS THIS RECORD BEFORE STARTING RECORD
YES
NO
p.3

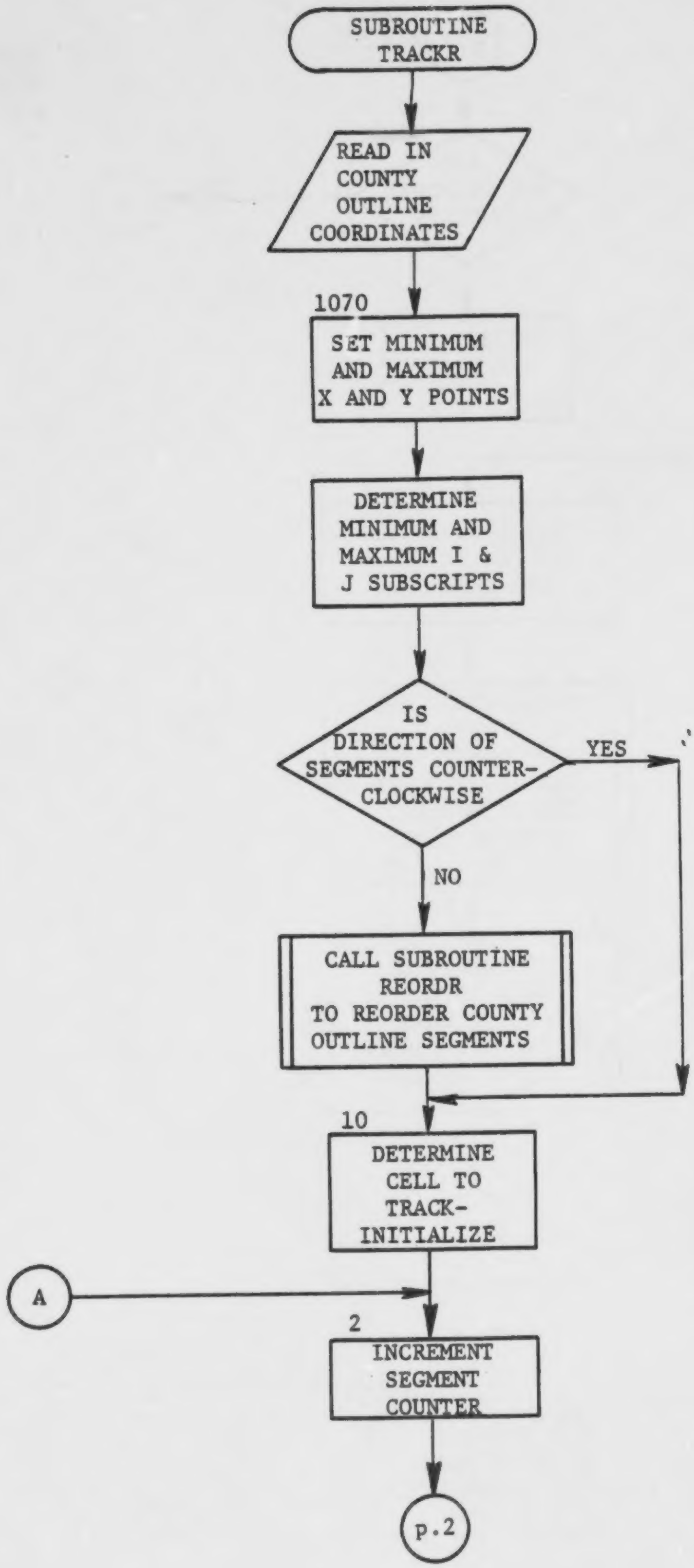

p.3
IS THIS RECORD THE STARTING RECORD
NO
WRITE ERROR MESSAGE GIVING COUNTY CODE
STOP 23
B
YES
1000
CONTINUE
WRITE RECORD OF NOUT3 IF NOUT > 0.
IS THIS A NEW COUNTY PROCESS HEADER RECORD
NO
C p.4
YES
IS THIS THE FIRST COUNTY
YES
NO
OUTPUT PREVIOUS COUNTY'S INFO
WANT COUNTY OUTLINES PLOTTED
YES
WRITE LINE SEGMENT TO TAPE
NO
1010
INITIALIZE FOR NEW COUNTY
D p.4


C
2000
INCREMENT # OF SEGMENTS FOR THIS COUNTY
IS ZONE OK
NO
WRITE ERROR MESSAGE "ZONE BAD"
STOP 25
YES
IS ZONE PRIMARY ZONE
NO
CALL SUBROUTINE GTGR TO CONVERT POINTS TO PRIMARY ZONE
YES
1011
CONTINUE
ERROR RETURNED
NO
YES
WRITE ERROR MESSAGE "BAD CONVERSION"
STOP 26
CALCULATE COORDS, FOR STARTING & ENDING NODES FOR THIS NODE
STORE COORDINATES IN STORAGE ARRAY
D
3000
READ IN A NEW RECORD
p.5

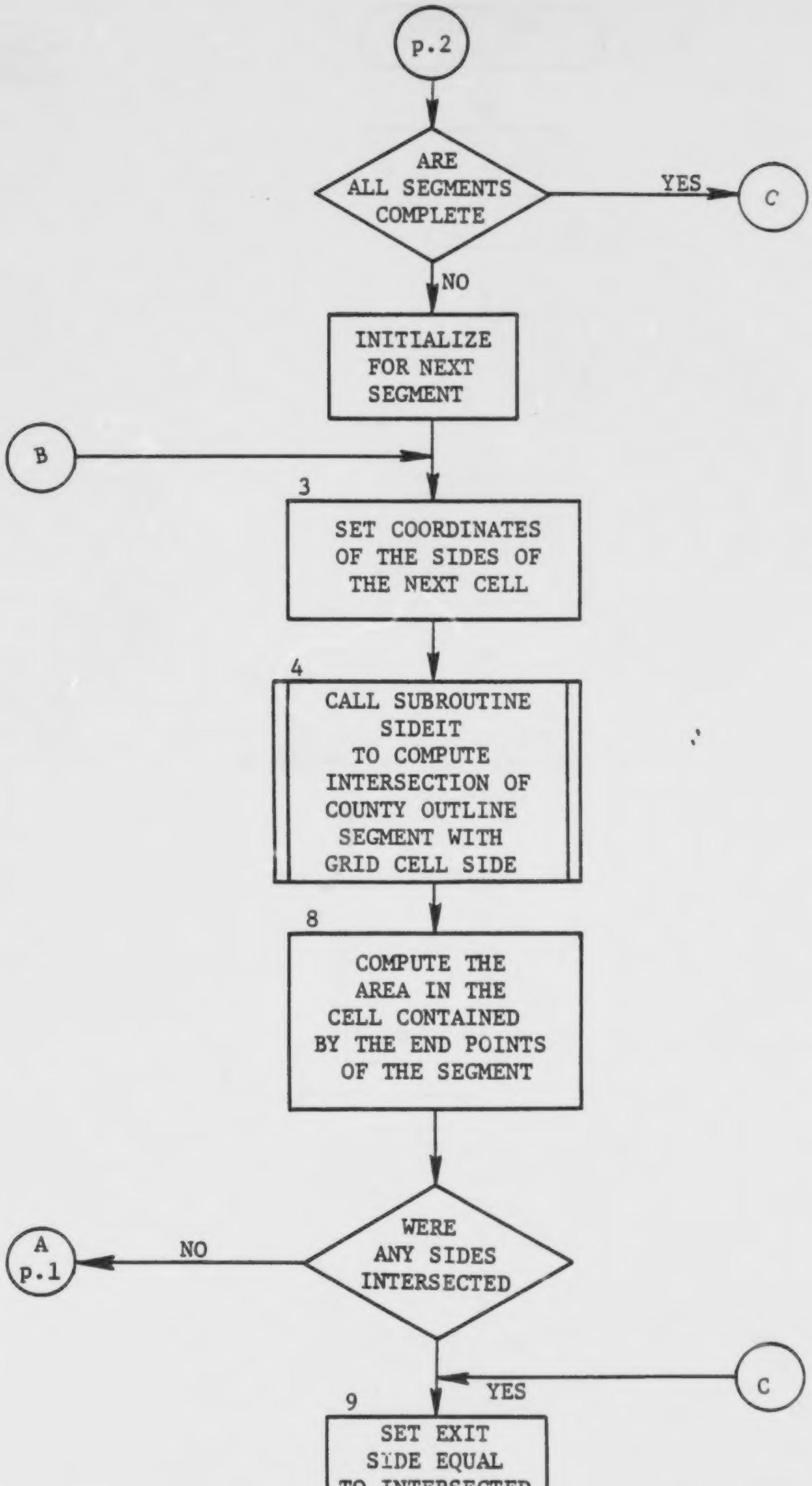

p.5
HAS END OF TAPE BEEN ENCOUNTERED
YES
E p.6
NO
DIVIDE COORDINATES VALUES BY 10
IS THIS SEGMENT A POINT
NO
D p.4
YES
IS THIS LAST COUNTY & LAST RECORD OF THIS COUNTY
YES
E p.6
NO
IS THIS RECORD FOR PRESENT COUNTY OR NEXT COUNTY
YES
B p.3
NO
IS ID OF THIS RECORD < ID OF NEXT COUNTY
NO
WRITE ERROR MESSAGE "STATE-COUNTY NOT IN OUTLINE FILE
STOP 28
YES
D p.4

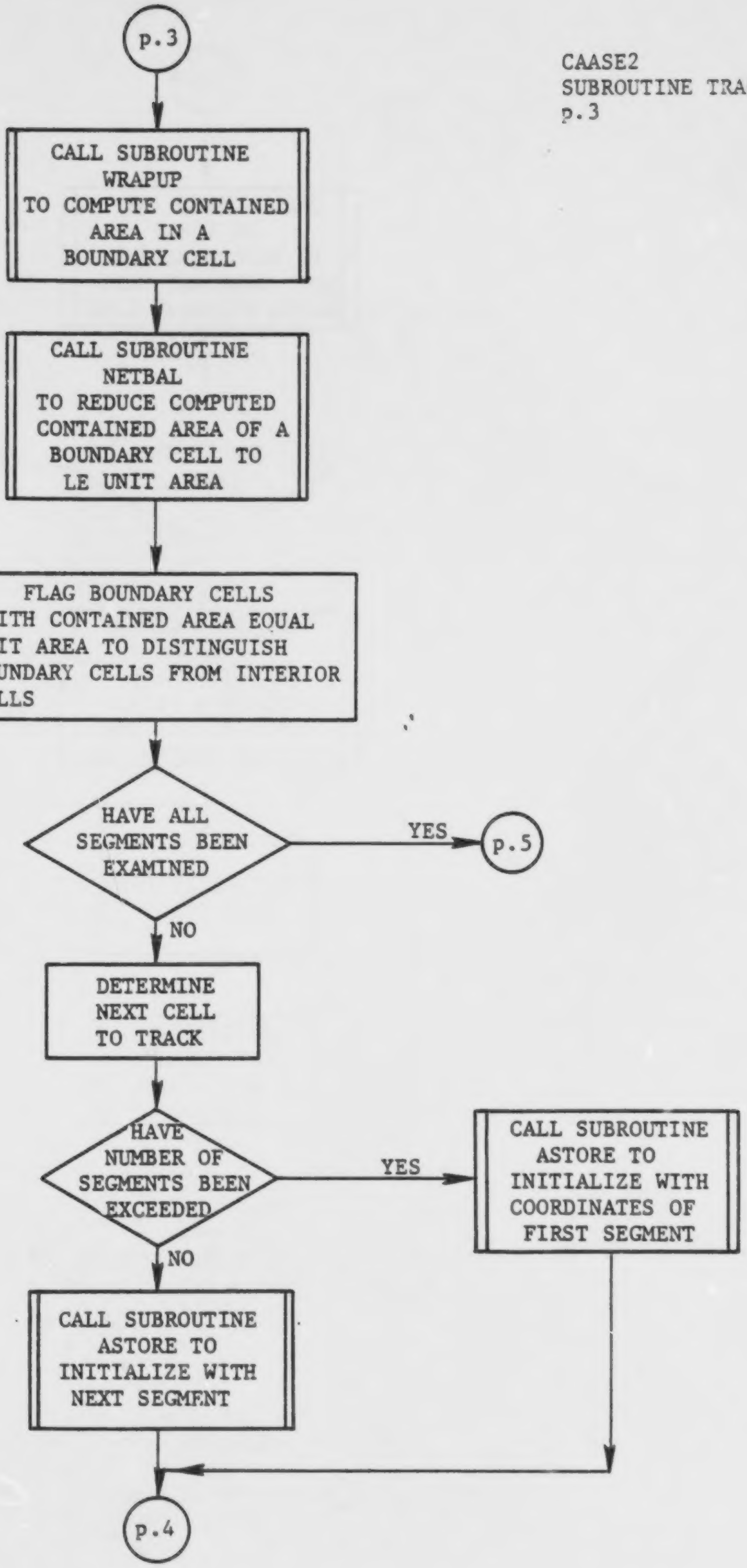

E
4000
CONTINUE
END OF COUNTY OUTPUT CURRENT COUNTY'S INFORMATION
SEARCH FOR MINIMUM AND MAXIMUM X & Y COORDINATES FOR ENTIRE STUDY AREA
IS SEGMENT MISSING
YES
WRITE ERROR MESSAGE
STOP 31
NO
WRITE SUMMARY RECORD FOR THIS COORDINATE
WRITE COORDINATES FOR THIS SEGMENT
WANT COUNTY OUTLINES PLOTTED
YES
WRITE LINE SEGMENT TO TAPE
NO
p.7

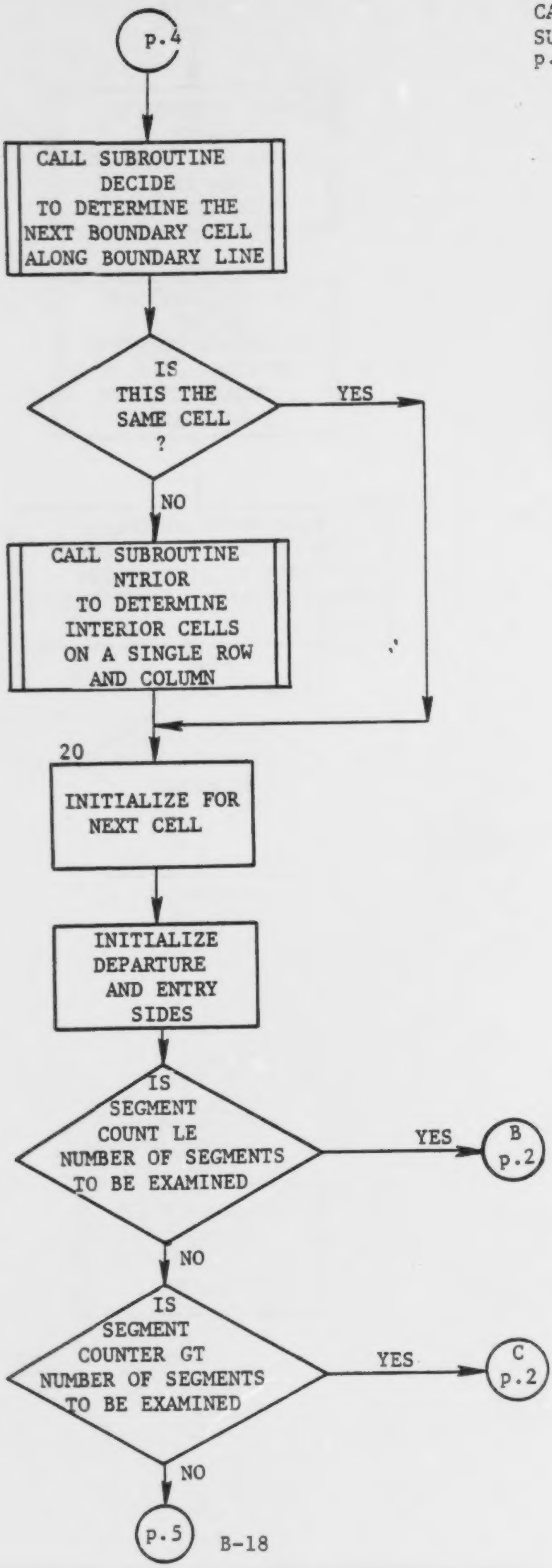

p.7
IS COUNTY ID ON RECORD JUST READ IN ORDER
NO
WRITE MESSAGE STATE COUNTY CODE NOT IN OUTLINE FILE
STOP 29
YES
CALCULATE ORIGIN OF STUDY AREA, INITIAL GRID SQUARE BASED ON EXTREME COORDS OF STUDY AREA.
RETURN TO CALLING PROGRAM

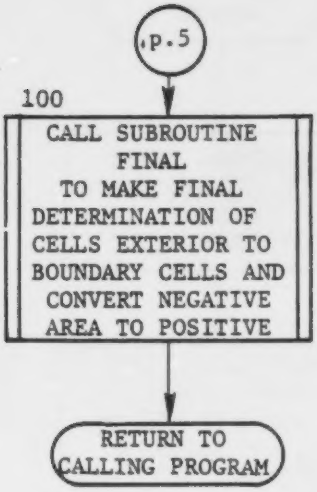

SUBROUTINE TRACKR
READ IN COUNTY OUTLINE COORDINATES
1070
SET MINIMUM AND MAXIMUM X AND Y POINTS
DETERMINE MINIMUM AND MAXIMUM I & J SUBSCRIPTS
IS DIRECTION OF SEGMENTS COUNTER-CLOCKWISE
YES
NO
CALL SUBROUTINE REORDR TO REORDER COUNTY OUTLINE SEGMENTS
10
DETERMINE CELL TO TRACK-INITIALIZE
A
2
INCREMENT SEGMENT COUNTER
p.2

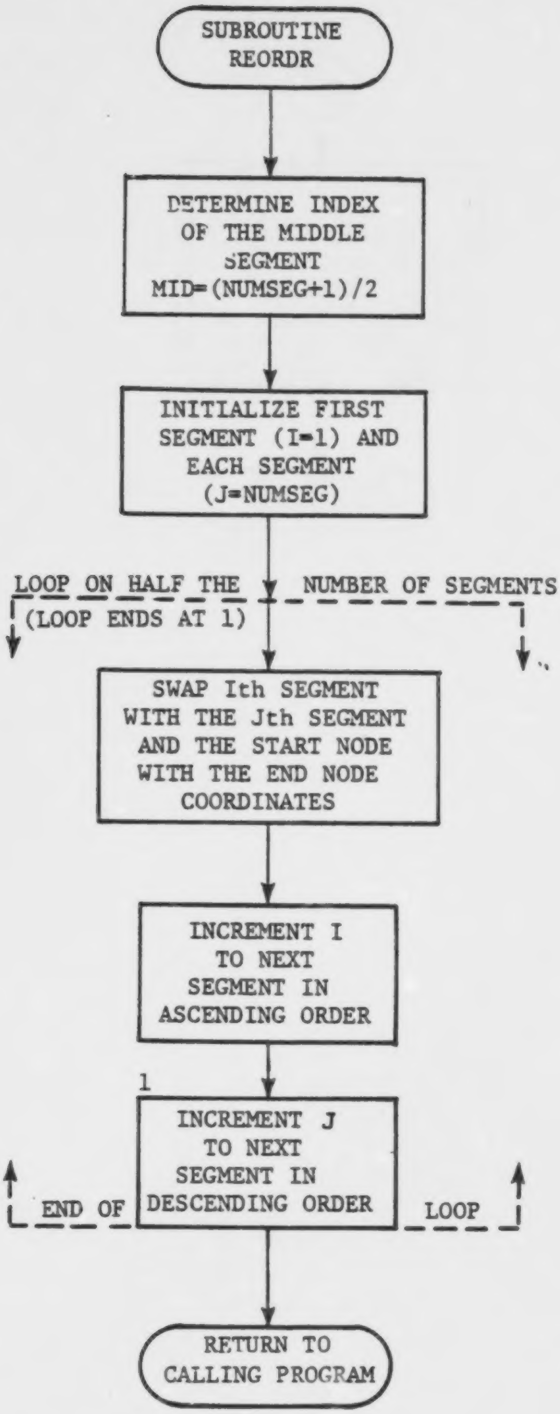
CAASE2
SUBROUTINE TRACKR
p.2

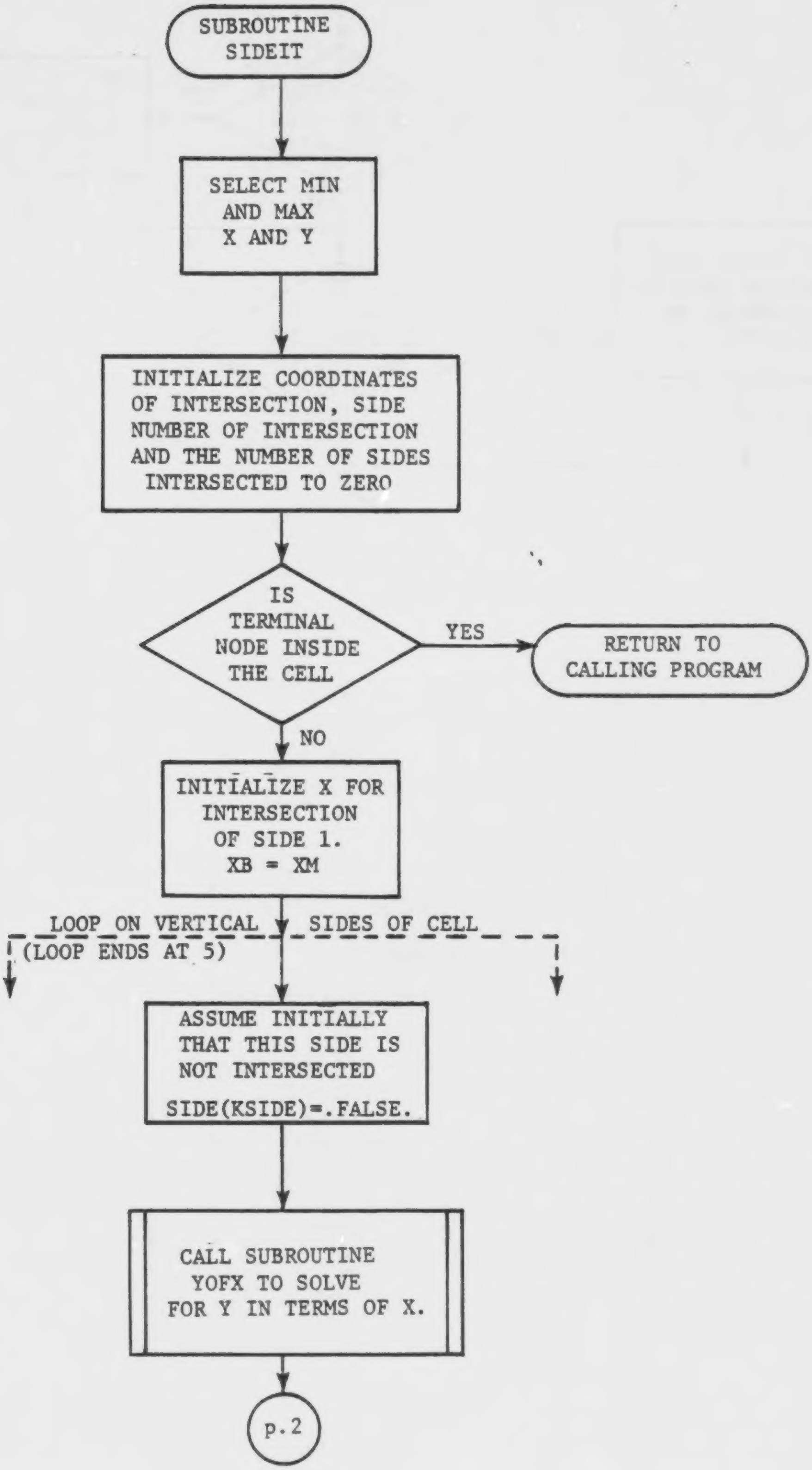

p.2
ARE ALL SEGMENTS COMPLETE
YES
C
NO
INITIALIZE FOR NEXT SEGMENT
B
3
SET COORDINATES OF THE SIDES OF THE NEXT CELL
4
CALL SUBROUTINE SIDEIT TO COMPUTE INTERSECTION OF COUNTY OUTLINE SEGMENT WITH GRID CELL SIDE
8
COMPUTE THE AREA IN THE CELL CONTAINED BY THE END POINTS OF THE SEGMENT
WERE ANY SIDES INTERSECTED
NO
A
p.1
C
YES
9
SET EXIT SIDE EQUAL TO INTERSECTED SIDE
p.3

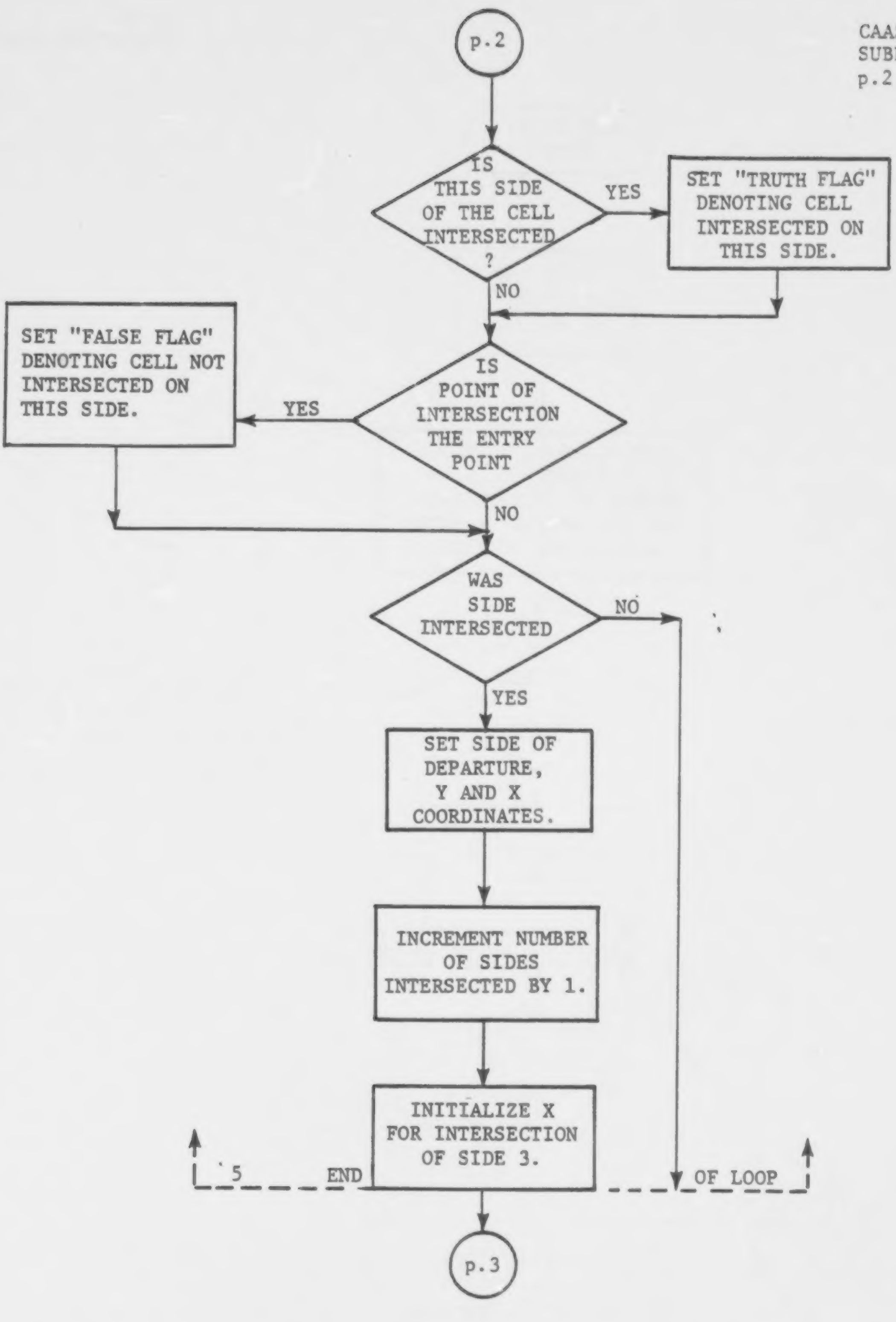

p.3
CALL SUBROUTINE WRAPUP TO COMPUTE CONTAINED AREA IN A BOUNDARY CELL
CALL SUBROUTINE NETBAL TO REDUCE COMPUTED CONTAINED AREA OF A BOUNDARY CELL TO LE UNIT AREA
FLAG BOUNDARY CELLS WITH CONTAINED AREA EQUAL UNIT AREA TO DISTINGUISH BOUNDARY CELLS FROM INTERIOR CELLS
HAVE ALL SEGMENTS BEEN EXAMINED
YES
p.5
NO
DETERMINE NEXT CELL TO TRACK
HAVE NUMBER OF SEGMENTS BEEN EXCEEDED
YES
CALL SUBROUTINE ASTORE TO INITIALIZE WITH COORDINATES OF FIRST SEGMENT
NO
CALL SUBROUTINE ASTORE TO INITIALIZE WITH NEXT SEGMENT
p.4

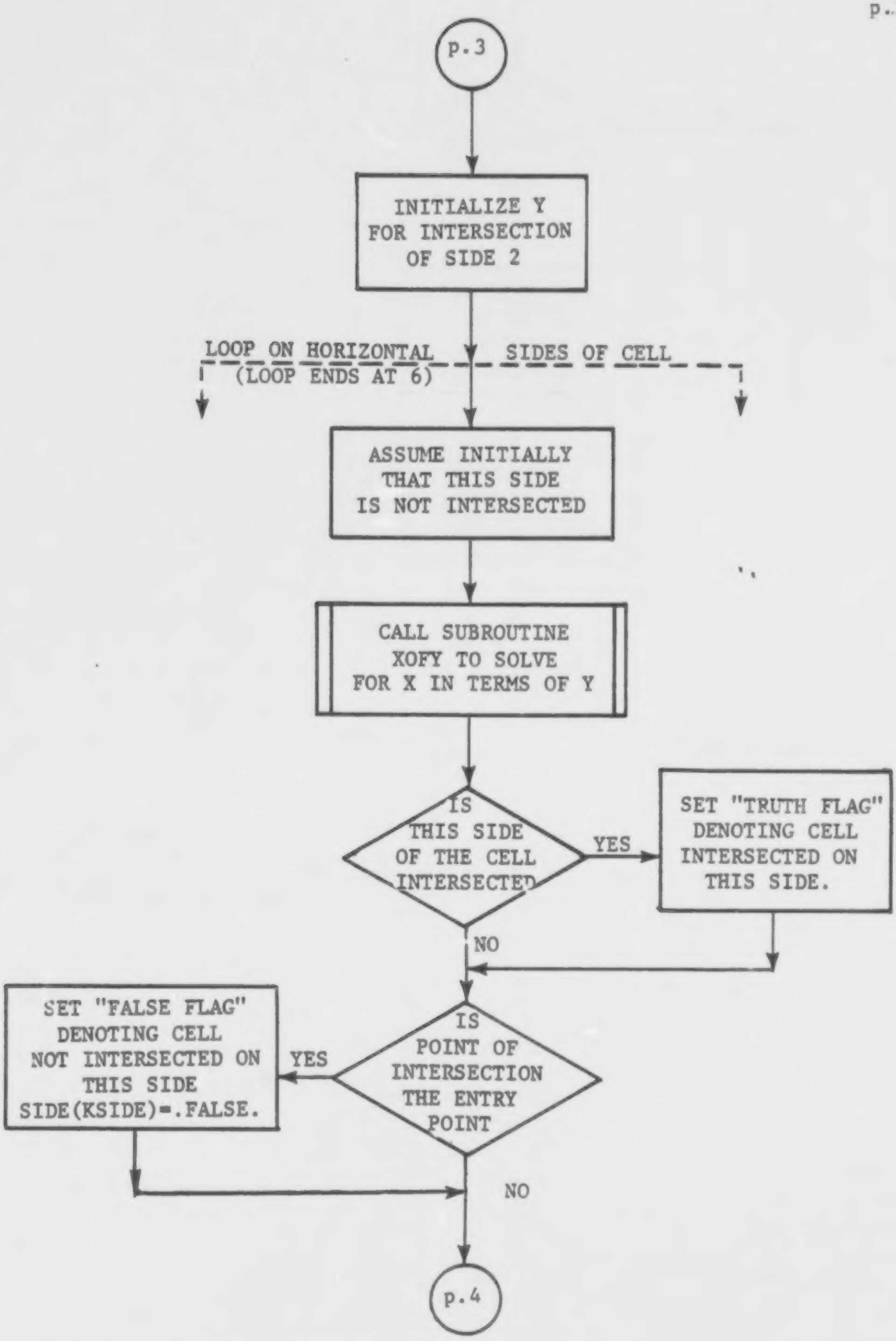

p.4
CALL SUBROUTINE DECIDE TO DETERMINE THE NEXT BOUNDARY CELL ALONG BOUNDARY LINE
IS THIS THE SAME CELL ?
YES
NO
CALL SUBROUTINE NTRIOR TO DETERMINE INTERIOR CELLS ON A SINGLE ROW AND COLUMN
20
INITIALIZE FOR NEXT CELL
INITIALIZE DEPARTURE AND ENTRY SIDES
IS SEGMENT COUNT LE NUMBER OF SEGMENTS TO BE EXAMINED
YES
B p.2
NO
IS SEGMENT COUNTER GT NUMBER OF SEGMENTS TO BE EXAMINED
YES
C p.2
NO
p.5

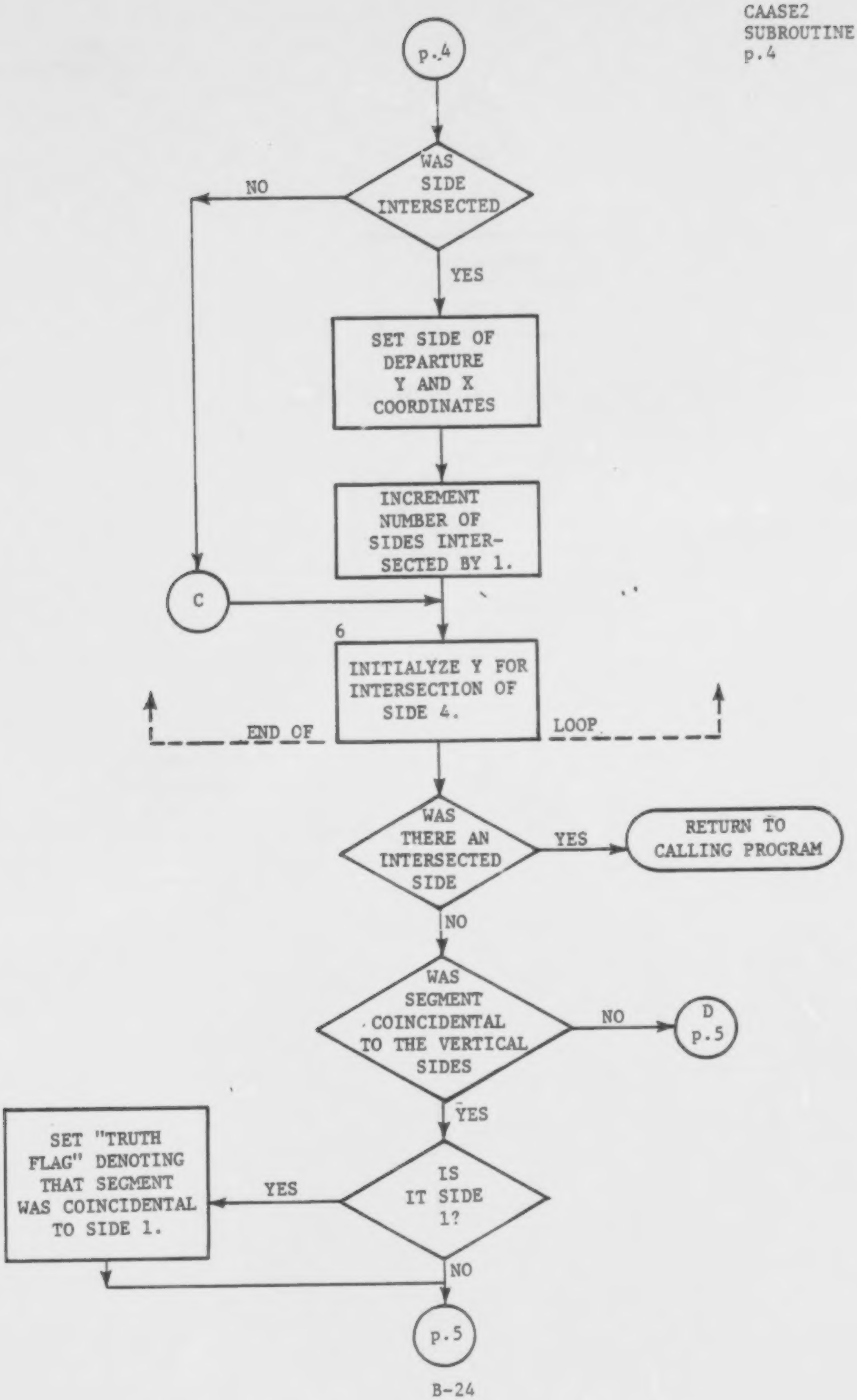

p.5
100
CALL SUBROUTINE FINAL TO MAKE FINAL DETERMINATION OF CELLS EXTERIOR TO BOUNDARY CELLS AND CONVERT NEGATIVE AREA TO POSITIVE
RETURN TO CALLING PROGRAM


SUBROUTINE REORDR
DETERMINE INDEX OF THE MIDDLE SEGMENT MID=(NUMSEG+1)/2
INITIALIZE FIRST SEGMENT (I=1) AND EACH SEGMENT (J=NUMSEG)
LOOP ON HALF THE NUMBER OF SEGMENTS
(LOOP ENDS AT 1)
SWAP Ith SEGMENT WITH THE Jth SEGMENT AND THE START NODE WITH THE END NODE COORDINATES
INCREMENT I TO NEXT SEGMENT IN ASCENDING ORDER
1
INCREMENT J TO NEXT SEGMENT IN DESCENDING ORDER
END OF
LOOP
RETURN TO CALLING PROGRAM

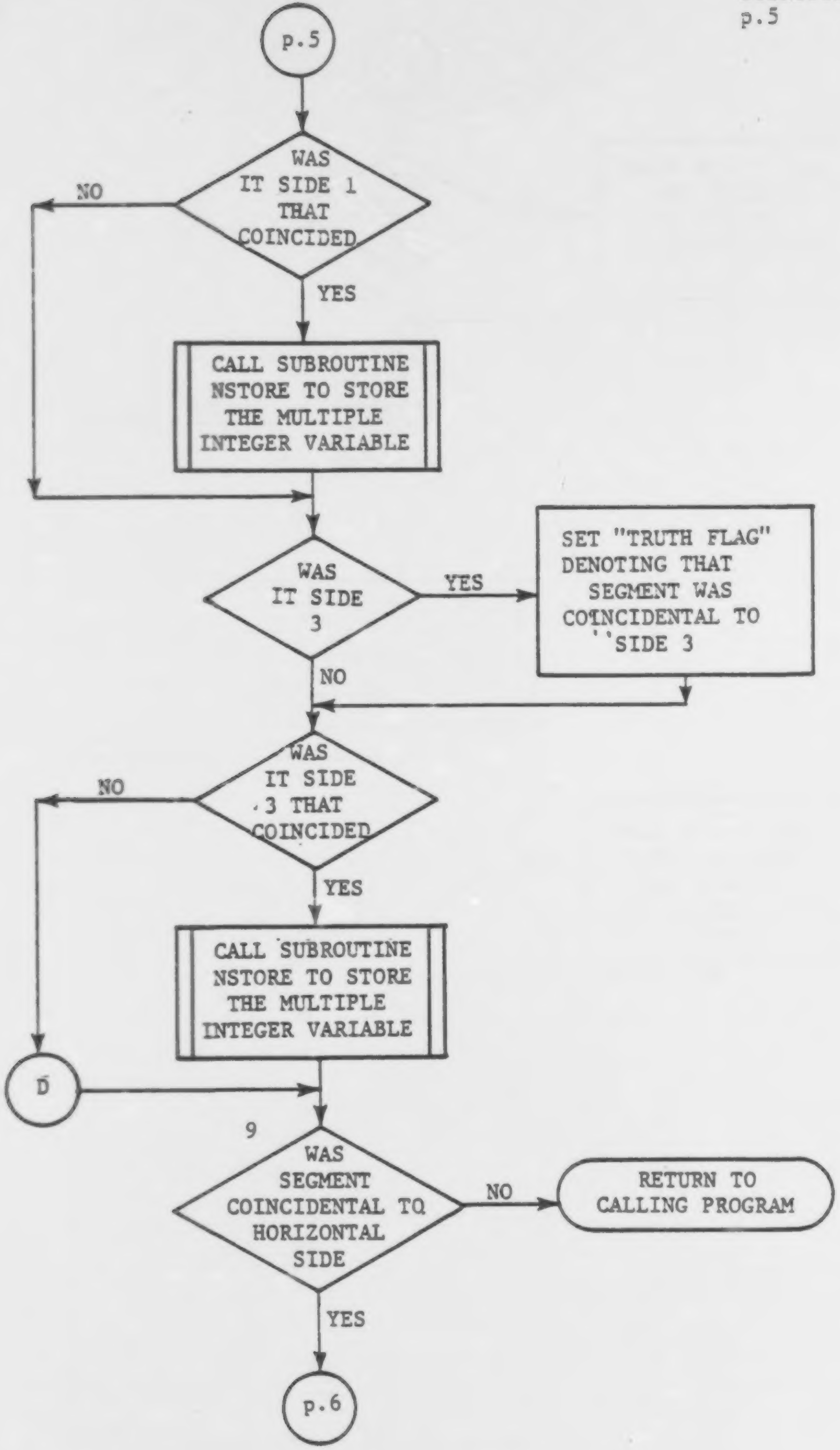

SUBROUTINE SIDEIT
SELECT MIN AND MAX X AND Y
INITIALIZE COORDINATES OF INTERSECTION, SIDE NUMBER OF INTERSECTION AND THE NUMBER OF SIDES INTERSECTED TO ZERO
IS TERMINAL NODE INSIDE THE CELL
YES
RETURN TO CALLING PROGRAM
NO
INITIALIZE X FOR INTERSECTION OF SIDE 1. XB = XM
LOOP ON VERTICAL SIDES OF CELL
(LOOP ENDS AT 5)
ASSUME INITIALLY THAT THIS SIDE IS NOT INTERSECTED
SIDE(KSIDE)=.FALSE.
CALL SUBROUTINE YOFX TO SOLVE FOR Y IN TERMS OF X.
p.2


p.2
IS THIS SIDE OF THE CELL INTERSECTED ?
YES
SET "TRUTH FLAG" DENOTING CELL INTERSECTED ON THIS SIDE.
NO
SET "FALSE FLAG" DENOTING CELL NOT INTERSECTED ON THIS SIDE.
YES
IS POINT OF INTERSECTION THE ENTRY POINT
NO
WAS SIDE INTERSECTED
NO
YES
SET SIDE OF DEPARTURE, Y AND X COORDINATES.
INCREMENT NUMBER OF SIDES INTERSECTED BY 1.
INITIALIZE X FOR INTERSECTION OF SIDE 3.
5
END
OF LOOP
p.3

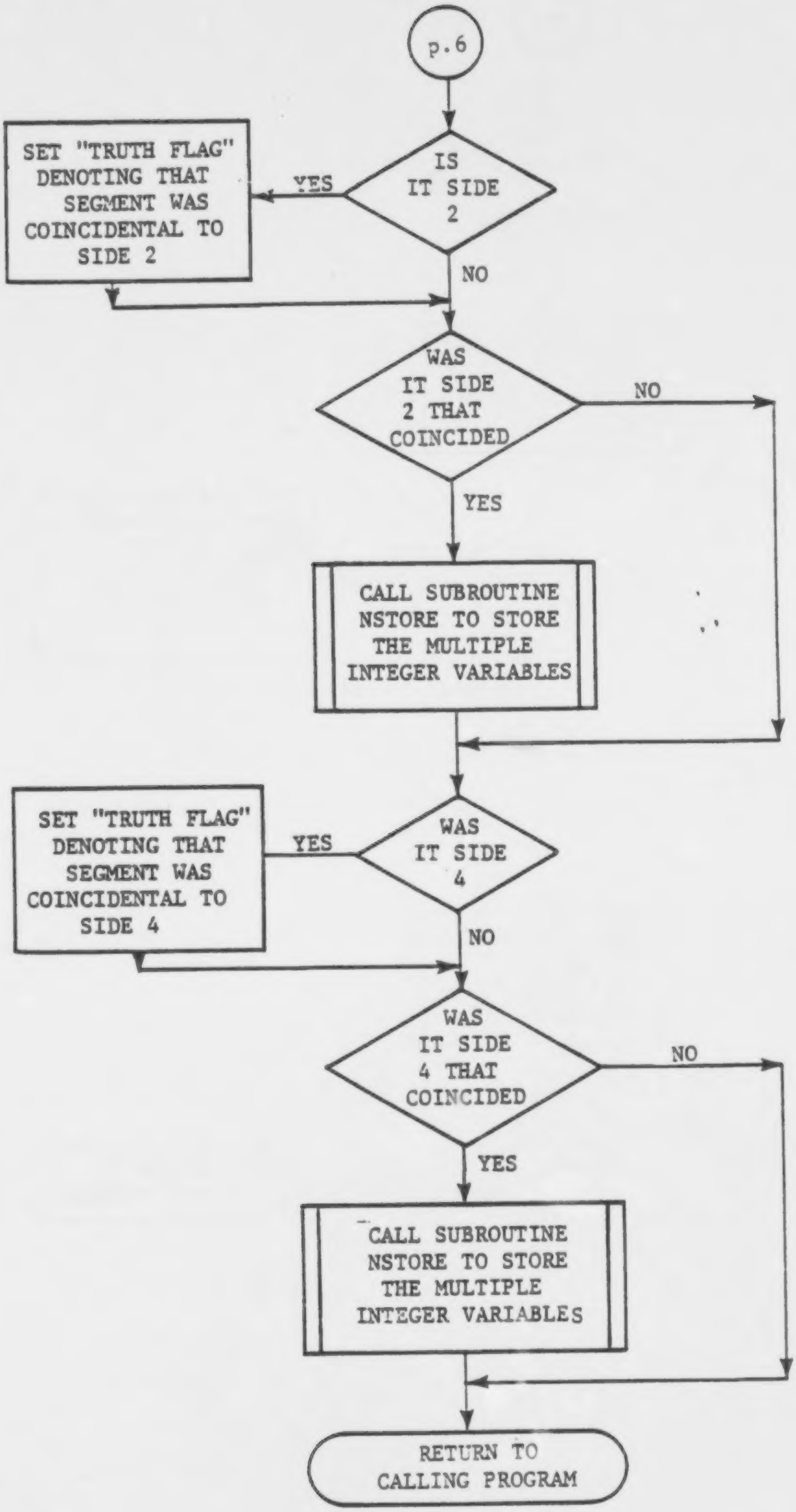

p.3
INITIALIZE Y FOR INTERSECTION OF SIDE 2
LOOP ON HORIZONTAL SIDES OF CELL
(LOOP ENDS AT 6)
ASSUME INITIALLY THAT THIS SIDE IS NOT INTERSECTED
CALL SUBROUTINE XOFY TO SOLVE FOR X IN TERMS OF Y
IS THIS SIDE OF THE CELL INTERSECTED
YES
SET "TRUTH FLAG" DENOTING CELL INTERSECTED ON THIS SIDE.
NO
IS POINT OF INTERSECTION THE ENTRY POINT
YES
SET "FALSE FLAG" DENOTING CELL NOT INTERSECTED ON THIS SIDE SIDE(KSIDE)=.FALSE.
NO
p.4

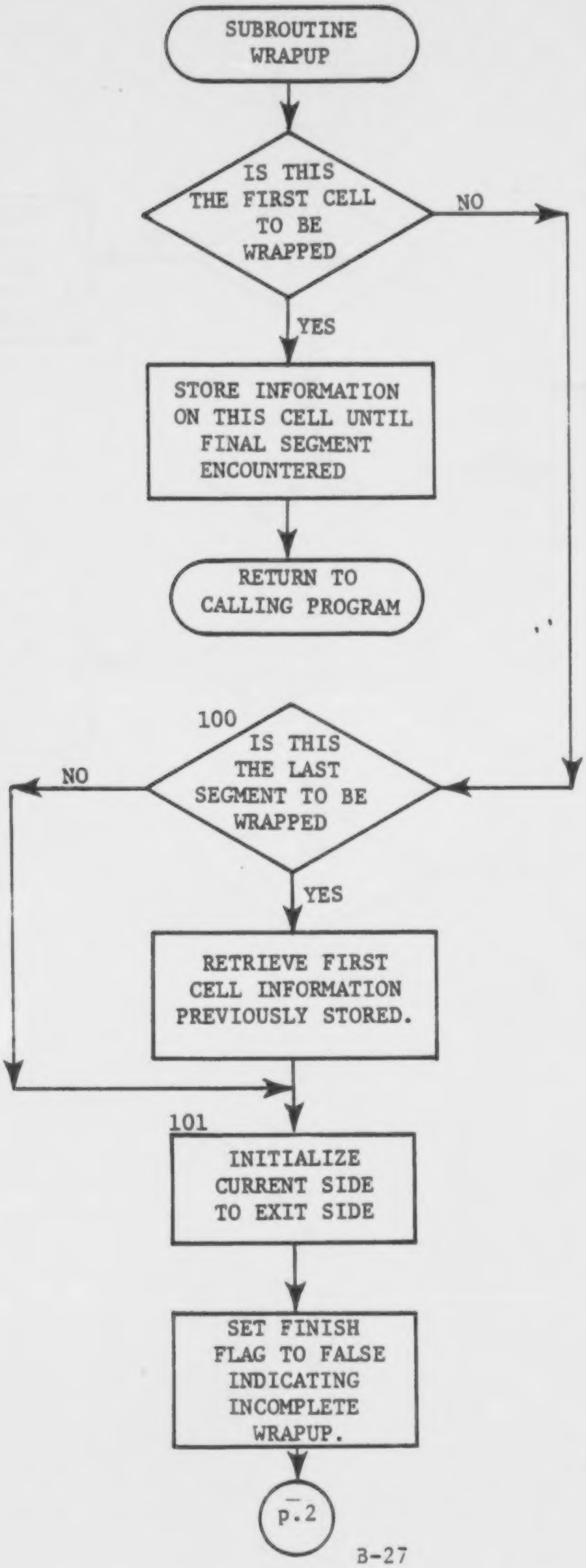

p.4
WAS SIDE INTERSECTED
NO
YES
SET SIDE OF DEPARTURE Y AND X COORDINATES
INCREMENT NUMBER OF SIDES INTER-SECTED BY 1.
C
6
INITIALYZE Y FOR INTERSECTION OF SIDE 4.
END OF
LOOP
WAS THERE AN INTERSECTED SIDE
YES
RETURN TO CALLING PROGRAM
NO
WAS SEGMENT COINCIDENTAL TO THE VERTICAL SIDES
NO
D p.5
YES
IS IT SIDE 1?
YES
SET "TRUTH FLAG" DENOTING THAT SEGMENT WAS COINCIDENTAL TO SIDE 1.
NO
p.5

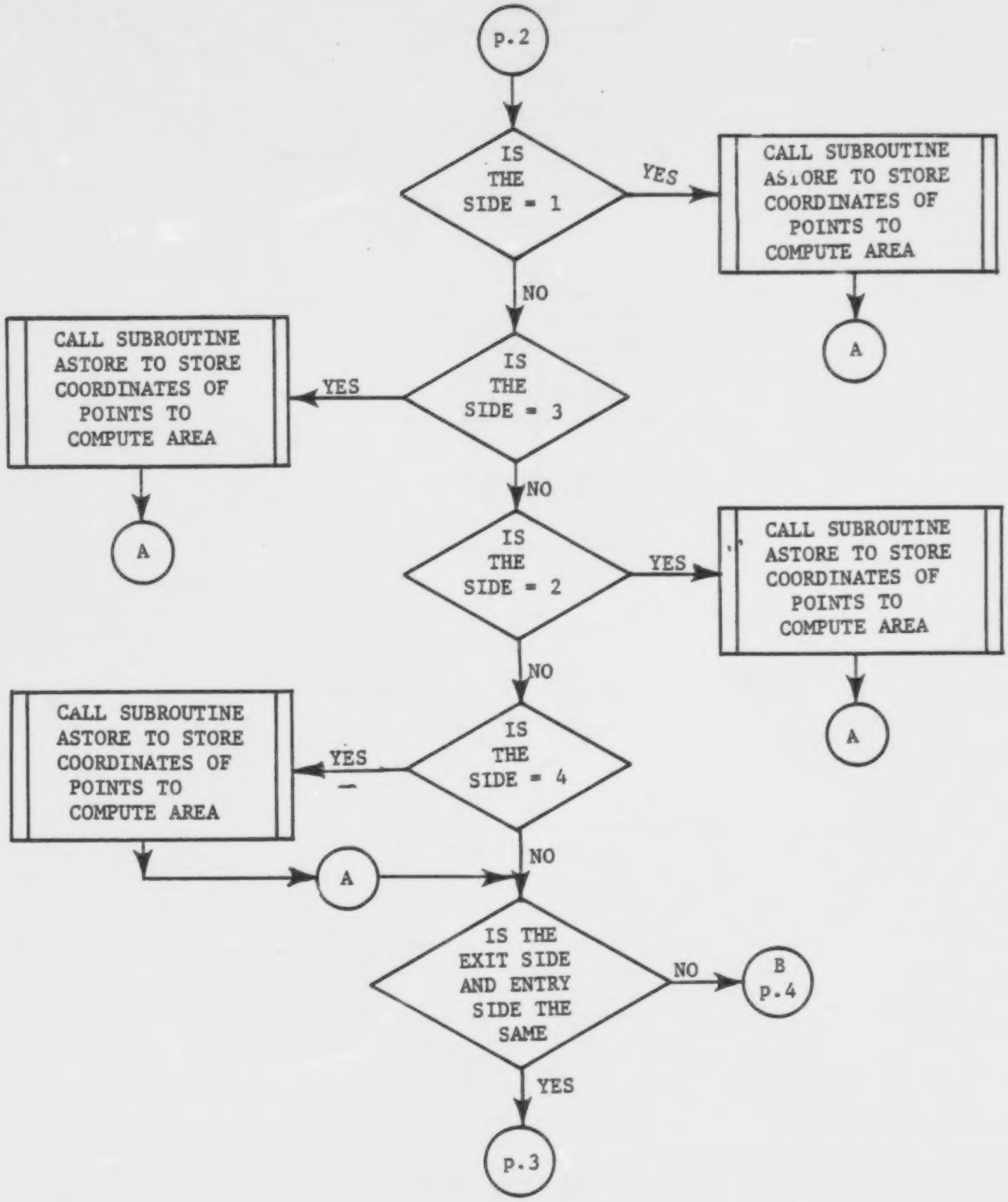
CAASE2
SUBROUTINE SIDEIT
p.5

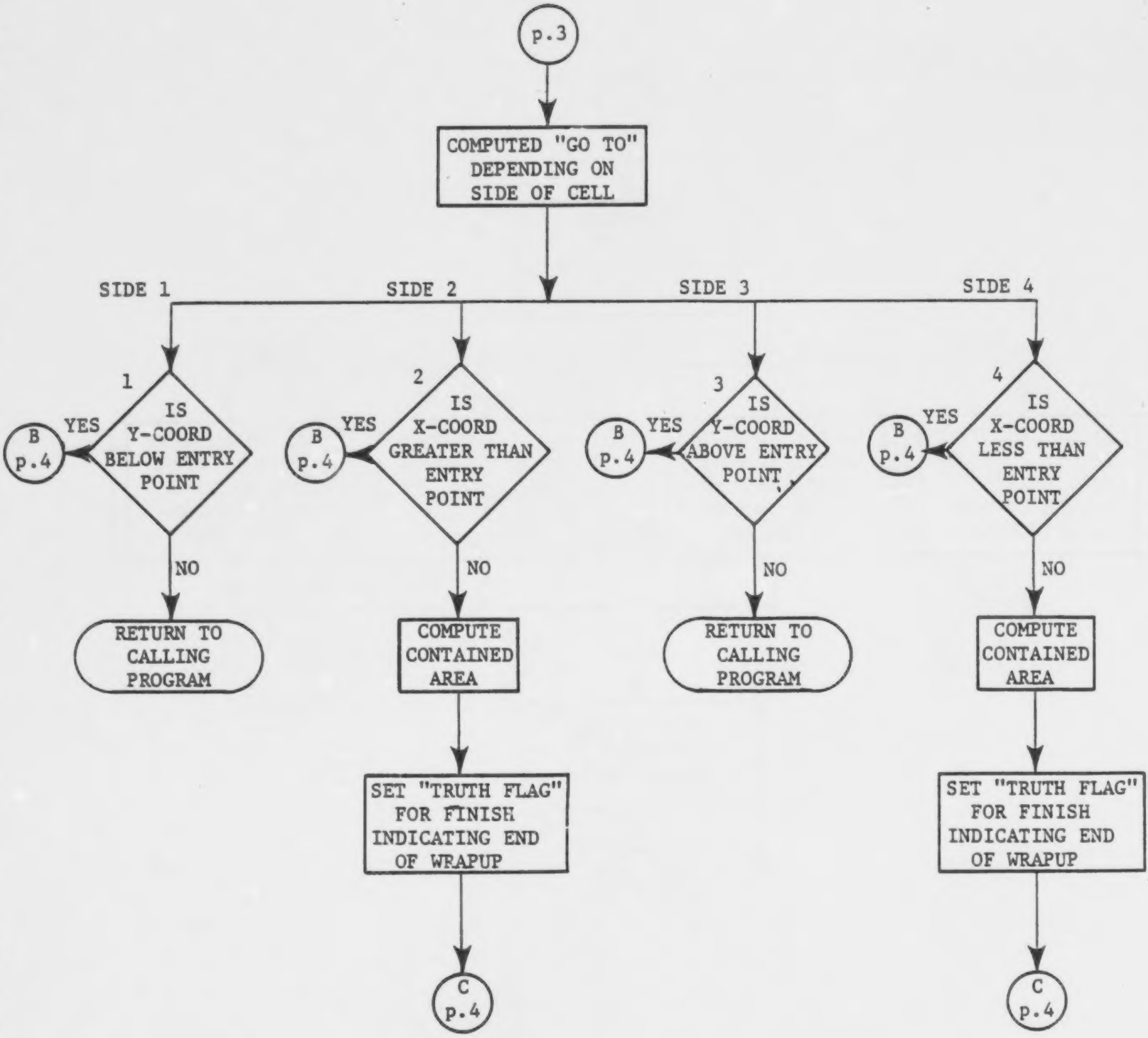


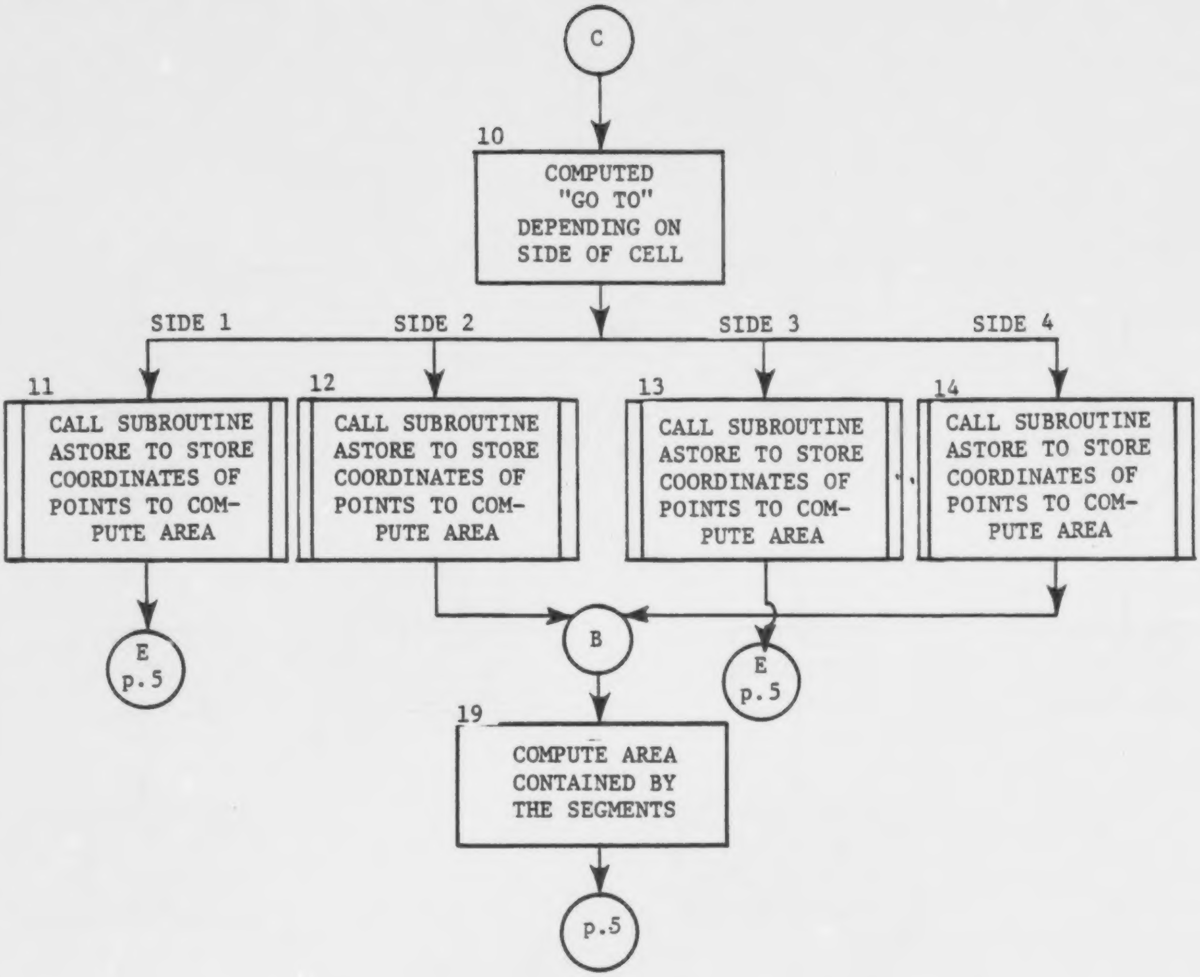
p.5
WAS IT SIDE 1 THAT COINCIDED
NO
YES
CALL SUBROUTINE NSTORE TO STORE THE MULTIPLE INTEGER VARIABLE
WAS IT SIDE 3
YES
SET "TRUTH FLAG" DENOTING THAT SEGMENT WAS COINCIDENTAL TO SIDE 3
NO
WAS IT SIDE 3 THAT COINCIDED
NO
YES
CALL SUBROUTINE NSTORE TO STORE THE MULTIPLE INTEGER VARIABLE
D
9
WAS SEGMENT COINCIDENTAL TO HORIZONTAL SIDE
NO
RETURN TO CALLING PROGRAM
YES
p.6

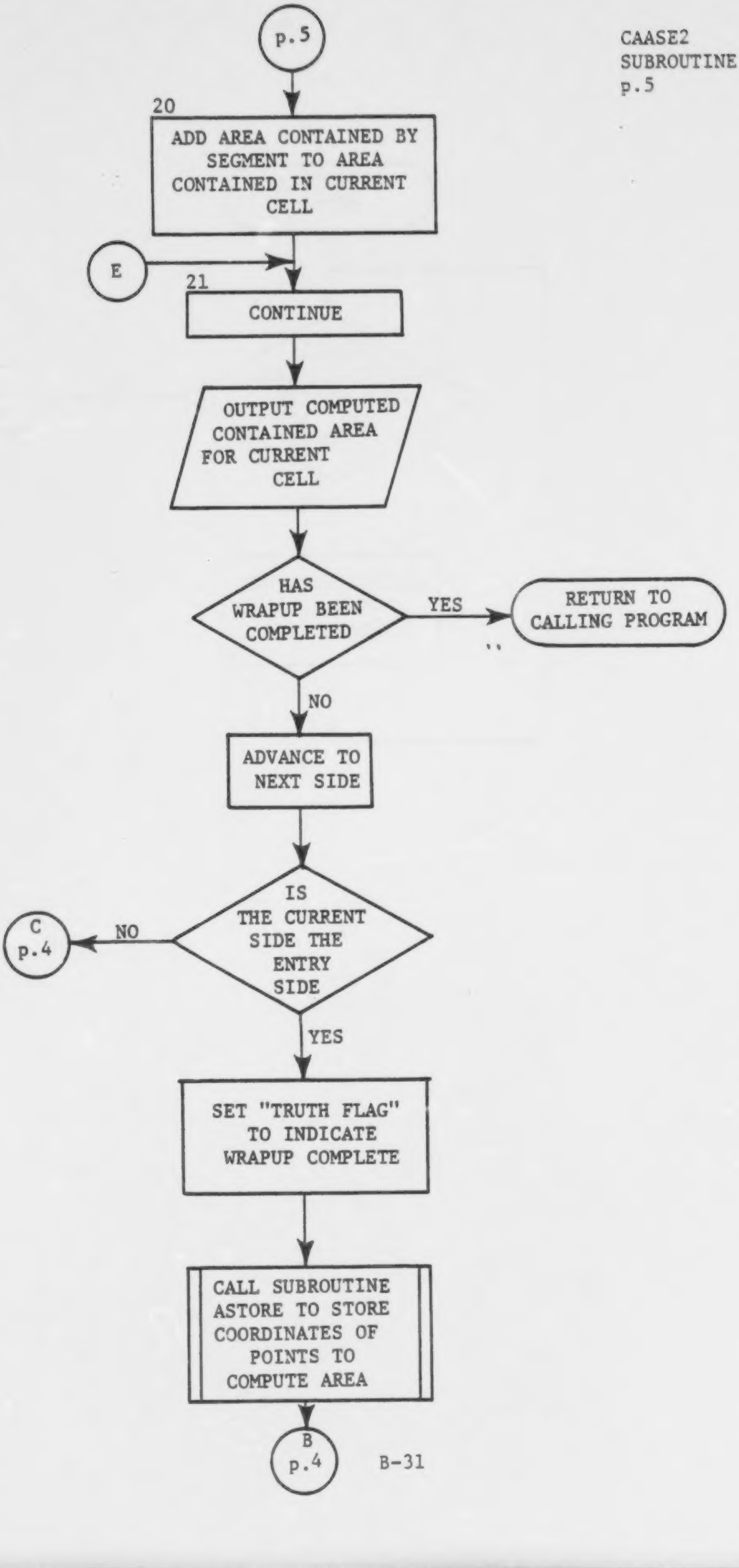

p.6
IS IT SIDE 2
YES
SET "TRUTH FLAG" DENOTING THAT SEGMENT WAS COINCIDENTAL TO SIDE 2
NO
WAS IT SIDE 2 THAT COINCIDED
NO
YES
CALL SUBROUTINE NSTORE TO STORE THE MULTIPLE INTEGER VARIABLES
WAS IT SIDE 4
YES
SET "TRUTH FLAG" DENOTING THAT SEGMENT WAS COINCIDENTAL TO SIDE 4
NO
WAS IT SIDE 4 THAT COINCIDED
NO
YES
CALL SUBROUTINE NSTORE TO STORE THE MULTIPLE INTEGER VARIABLES
RETURN TO CALLING PROGRAM

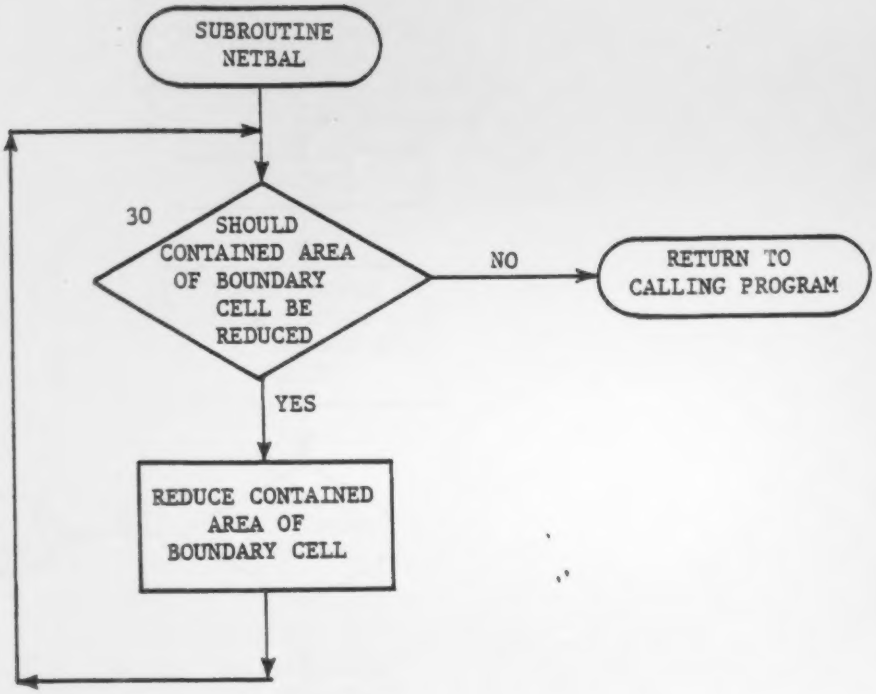

SUBROUTINE WRAPUP
IS THIS THE FIRST CELL TO BE WRAPPED
NO
YES
STORE INFORMATION ON THIS CELL UNTIL FINAL SEGMENT ENCOUNTERED
RETURN TO CALLING PROGRAM
100
IS THIS THE LAST SEGMENT TO BE WRAPPED
NO
YES
RETRIEVE FIRST CELL INFORMATION PREVIOUSLY STORED.
101
INITIALIZE CURRENT SIDE TO EXIT SIDE
SET FINISH FLAG TO FALSE INDICATING INCOMPLETE WRAPUP.
p.2

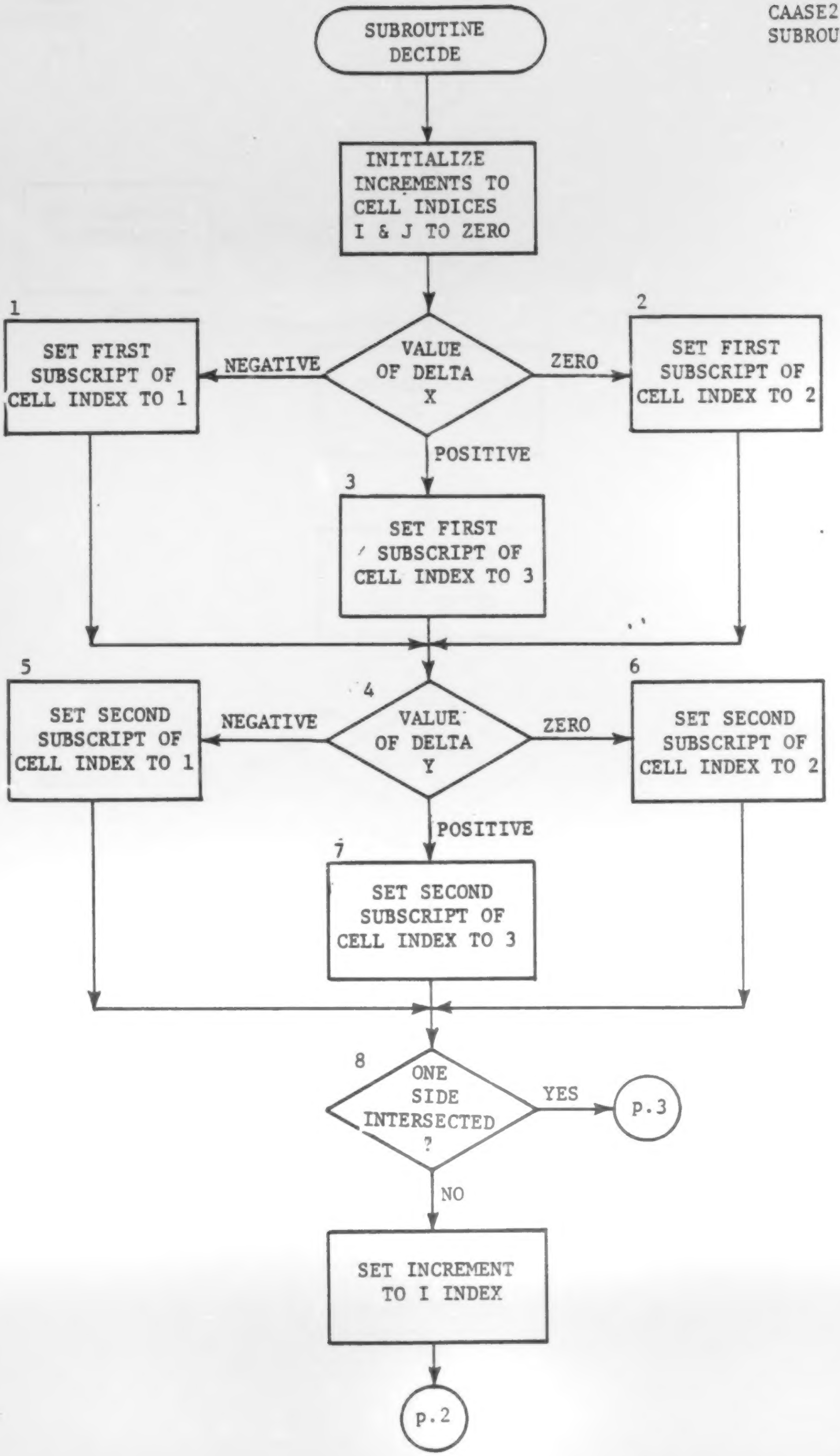

p.2
IS THE SIDE = 1
YES
CALL SUBROUTINE ASTORE TO STORE COORDINATES OF POINTS TO COMPUTE AREA
A
NO
IS THE SIDE = 3
YES
CALL SUBROUTINE ASTORE TO STORE COORDINATES OF POINTS TO COMPUTE AREA
A
NO
IS THE SIDE = 2
YES
CALL SUBROUTINE ASTORE TO STORE COORDINATES OF POINTS TO COMPUTE AREA
A
NO
IS THE SIDE = 4
YES
CALL SUBROUTINE ASTORE TO STORE COORDINATES OF POINTS TO COMPUTE AREA
A
NO
IS THE EXIT SIDE AND ENTRY SIDE THE SAME
NO
B p.4
YES
p.3

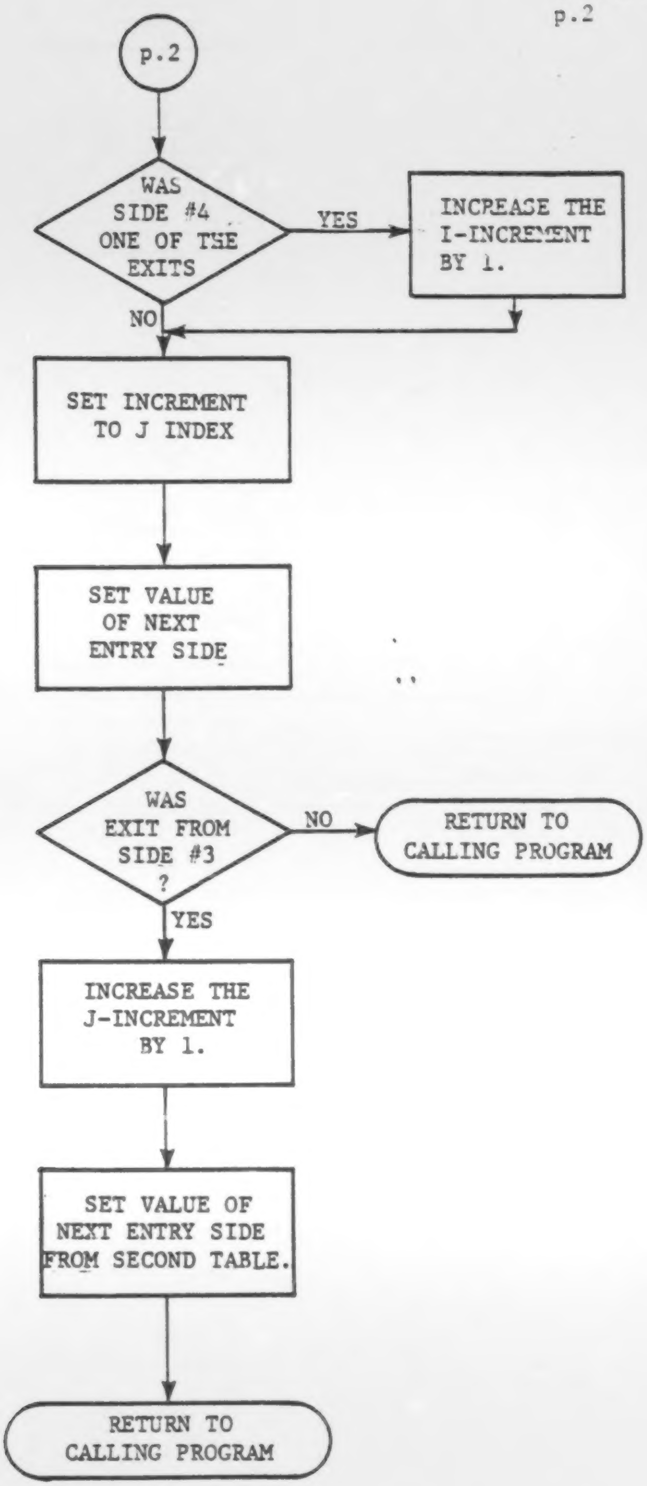

p.3
COMPUTED "GO TO" DEPENDING ON SIDE OF CELL
SIDE 1
SIDE 2
SIDE 3
SIDE 4
1
IS Y-COORD BELOW ENTRY POINT
YES
B p.4
NO
RETURN TO CALLING PROGRAM
2
IS X-COORD GREATER THAN ENTRY POINT
YES
B p.4
NO
COMPUTE CONTAINED AREA
SET "TRUTH FLAG" FOR FINISH INDICATING END OF WRAPUP
C p.4
3
IS Y-COORD ABOVE ENTRY POINT
YES
B p.4
NO
RETURN TO CALLING PROGRAM
4
IS X-COORD LESS THAN ENTRY POINT
YES
B p.4
NO
COMPUTE CONTAINED AREA
SET "TRUTH FLAG" FOR FINISH INDICATING END OF WRAPUP
C p.4

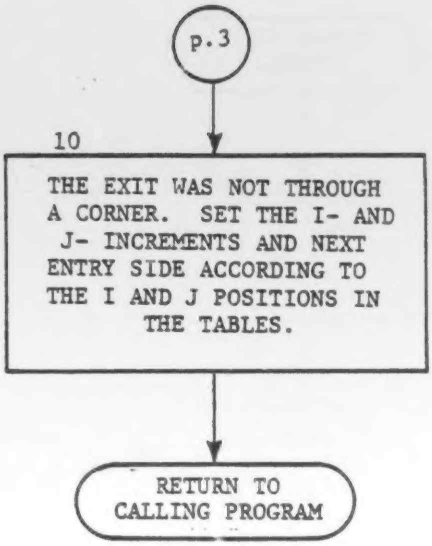

C
10
COMPUTED "GO TO" DEPENDING ON SIDE OF CELL
SIDE 1
SIDE 2
SIDE 3
SIDE 4
11
CALL SUBROUTINE ASTORE TO STORE COORDINATES OF POINTS TO COMPUTE AREA
12
CALL SUBROUTINE ASTORE TO STORE COORDINATES OF POINTS TO COMPUTE AREA
13
CALL SUBROUTINE ASTORE TO STORE COORDINATES OF POINTS TO COMPUTE AREA
14
CALL SUBROUTINE ASTORE TO STORE COORDINATES OF POINTS TO COMPUTE AREA
E p.5
B
E p.5
19
COMPUTE AREA CONTAINED BY THE SEGMENTS
p.5

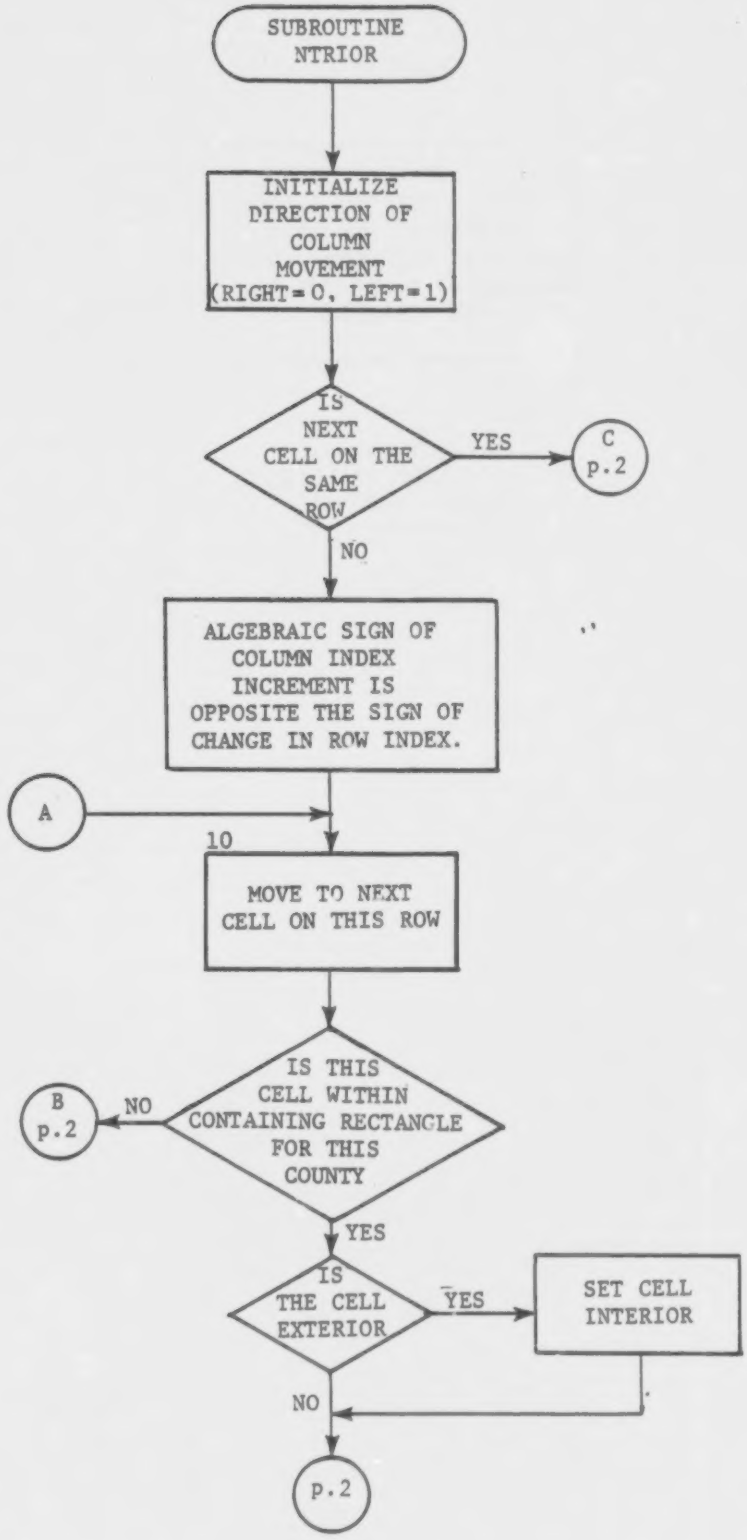

p.5
20
ADD AREA CONTAINED BY SEGMENT TO AREA CONTAINED IN CURRENT CELL
E
21
CONTINUE
OUTPUT COMPUTED CONTAINED AREA FOR CURRENT CELL
HAS WRAPUP BEEN COMPLETED
YES
RETURN TO CALLING PROGRAM
NO
ADVANCE TO NEXT SIDE
IS THE CURRENT SIDE THE ENTRY SIDE
NO
C p.4
YES
SET "TRUTH FLAG" TO INDICATE WRAPUP COMPLETE
CALL SUBROUTINE ASTORE TO STORE COORDINATES OF POINTS TO COMPUTE AREA
B p.4


SUBROUTINE NETBAL
30
SHOULD CONTAINED AREA OF BOUNDARY CELL BE REDUCED
NO
RETURN TO CALLING PROGRAM
YES
REDUCE CONTAINED AREA OF BOUNDARY CELL

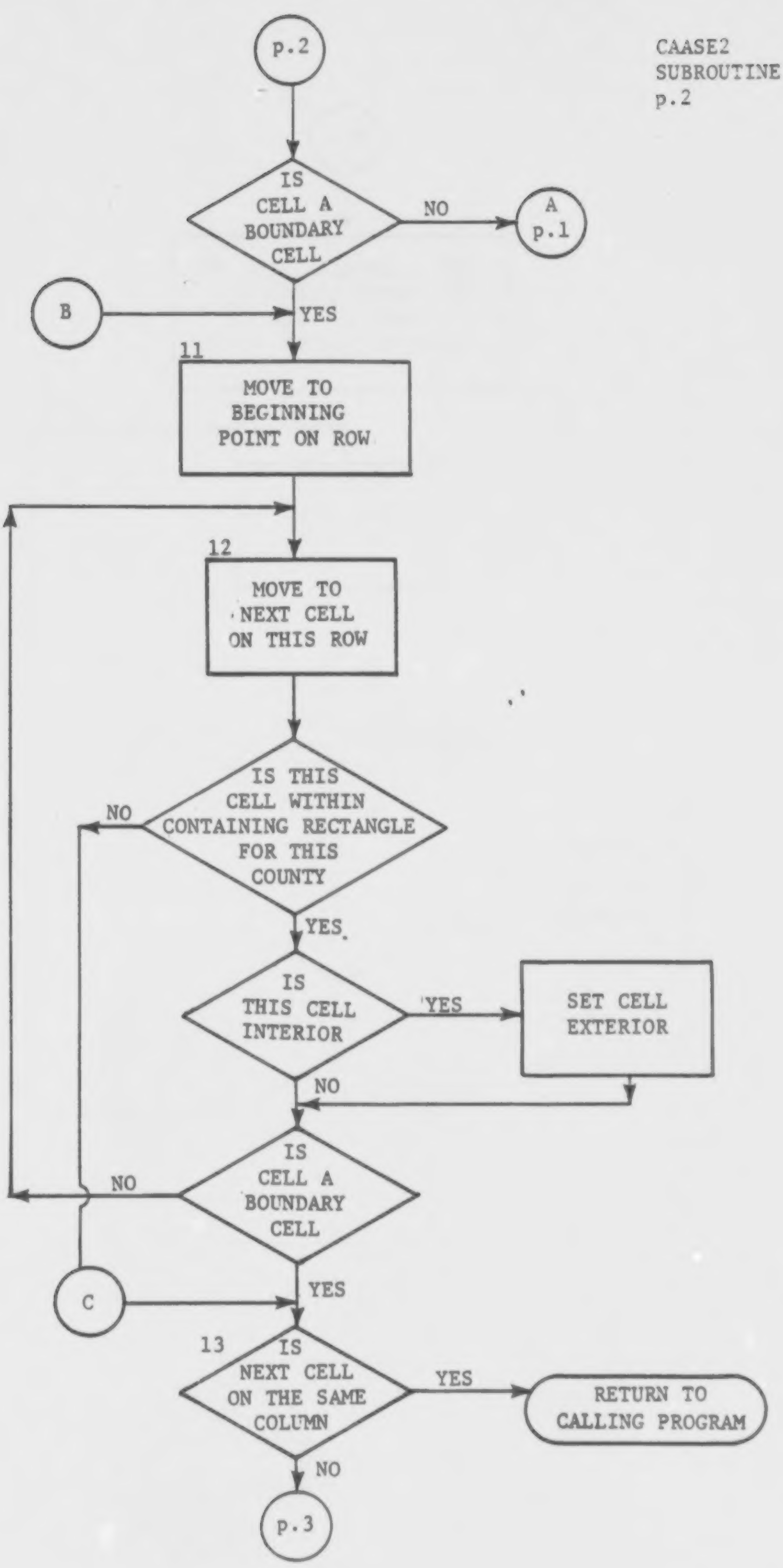

SUBROUTINE DECIDE
INITIALIZE INCREMENTS TO CELL INDICES I & J TO ZERO
1
SET FIRST SUBSCRIPT OF CELL INDEX TO 1
NEGATIVE
VALUE OF DELTA X
ZERO
2
SET FIRST SUBSCRIPT OF CELL INDEX TO 2
POSITIVE
3
SET FIRST SUBSCRIPT OF CELL INDEX TO 3
5
SET SECOND SUBSCRIPT OF CELL INDEX TO 1
NEGATIVE
4
VALUE OF DELTA Y
ZERO
6
SET SECOND SUBSCRIPT OF CELL INDEX TO 2
POSITIVE
7
SET SECOND SUBSCRIPT OF CELL INDEX TO 3
8
ONE SIDE INTERSECTED ?
YES
p.3
NO
SET INCREMENT TO I INDEX
p.2

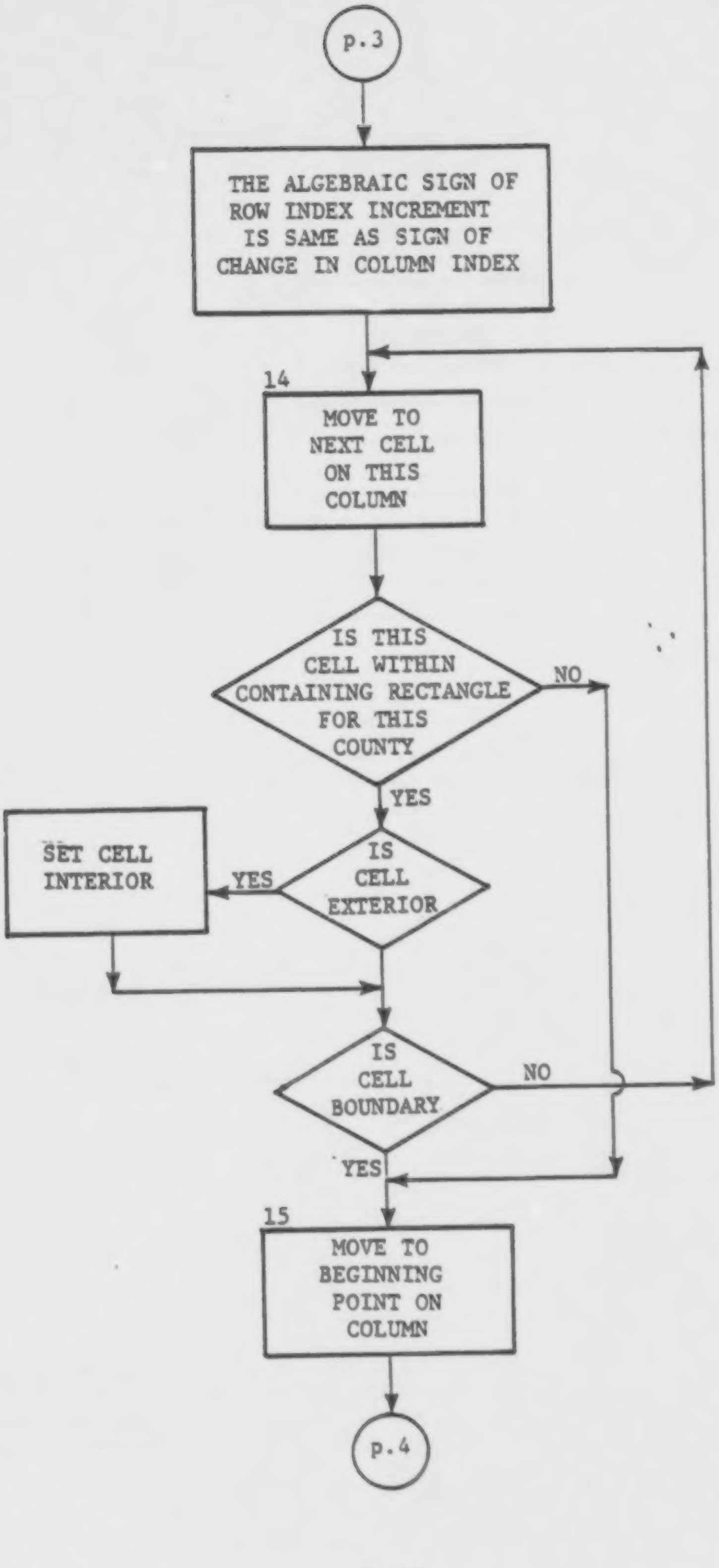

p.2
WAS SIDE #4 ONE OF THE EXITS
YES
INCREASE THE I-INCREMENT BY 1.
NO
SET INCREMENT TO J INDEX
SET VALUE OF NEXT ENTRY SIDE
WAS EXIT FROM SIDE #3 ?
NO
RETURN TO CALLING PROGRAM
YES
INCREASE THE J-INCREMENT BY 1.
SET VALUE OF NEXT ENTRY SIDE FROM SECOND TABLE.
RETURN TO CALLING PROGRAM

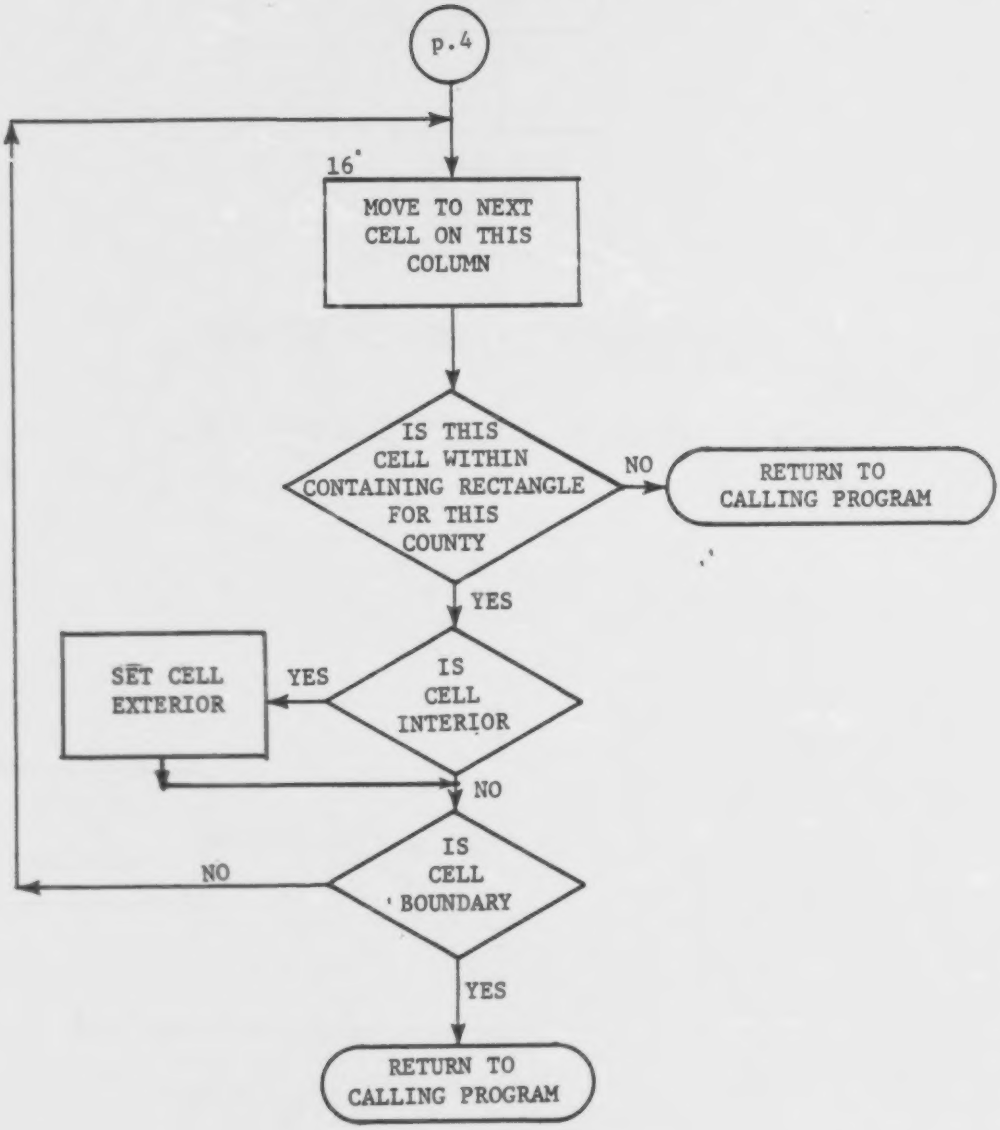

p.3
10
THE EXIT WAS NOT THROUGH A CORNER. SET THE I- AND J- INCREMENTS AND NEXT ENTRY SIDE ACCORDING TO THE I AND J POSITIONS IN THE TABLES.
RETURN TO CALLING PROGRAM

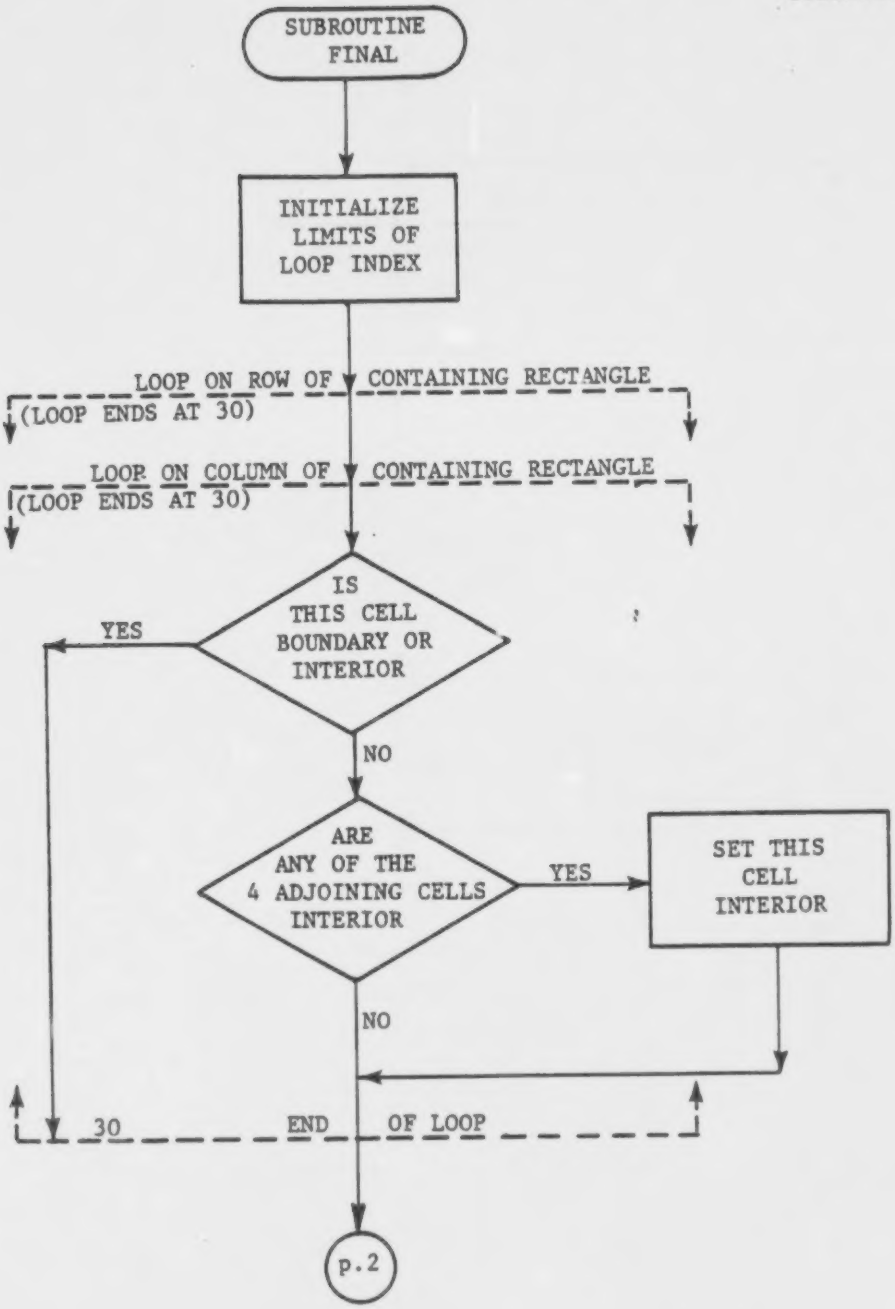

SUBROUTINE NTRIOR
INITIALIZE DIRECTION OF COLUMN MOVEMENT (RIGHT=0, LEFT=1)
IS NEXT CELL ON THE SAME ROW
YES
C p.2
NO
ALGEBRAIC SIGN OF COLUMN INDEX INCREMENT IS OPPOSITE THE SIGN OF CHANGE IN ROW INDEX.
A
10
MOVE TO NEXT CELL ON THIS ROW
IS THIS CELL WITHIN CONTAINING RECTANGLE FOR THIS COUNTY
NO
B p.2
YES
IS THE CELL EXTERIOR
YES
SET CELL INTERIOR
NO
p.2

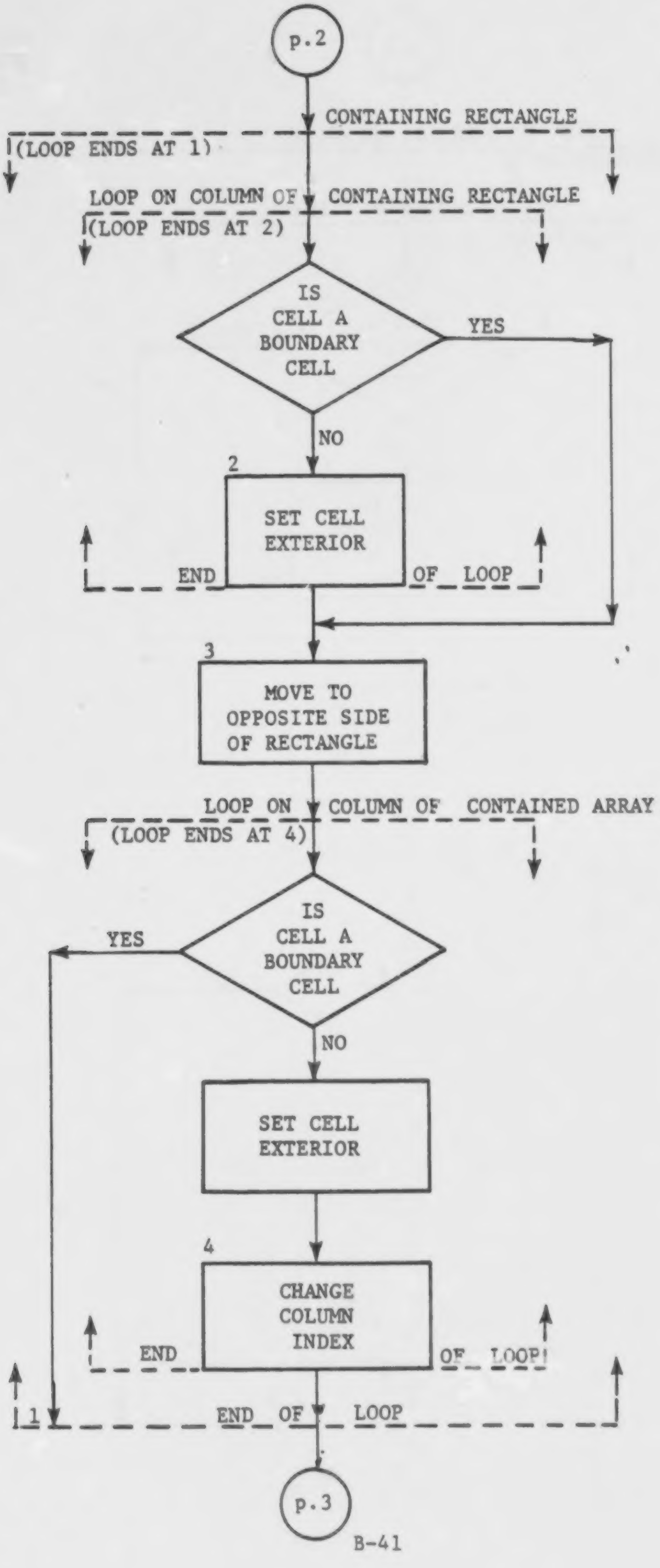
CAASE2
SUBROUTINE NTRIOR
p.2

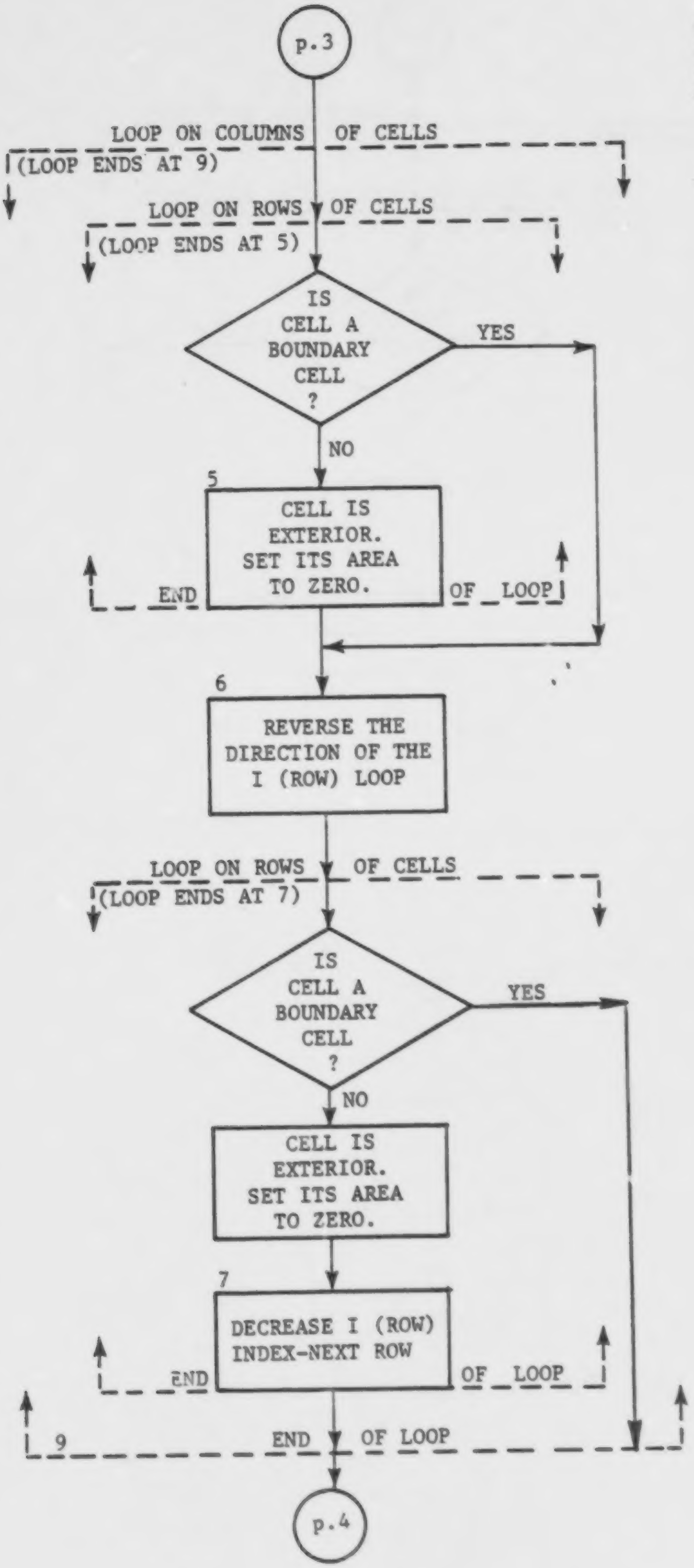

p.2
IS CELL A BOUNDARY CELL
NO
A p.1
B
YES
11
MOVE TO BEGINNING POINT ON ROW
12
MOVE TO NEXT CELL ON THIS ROW
IS THIS CELL WITHIN CONTAINING RECTANGLE FOR THIS COUNTY
NO
YES
IS THIS CELL INTERIOR
YES
SET CELL EXTERIOR
NO
IS CELL A BOUNDARY CELL
NO
YES
C
13
IS NEXT CELL ON THE SAME COLUMN
YES
RETURN TO CALLING PROGRAM
NO
p.3

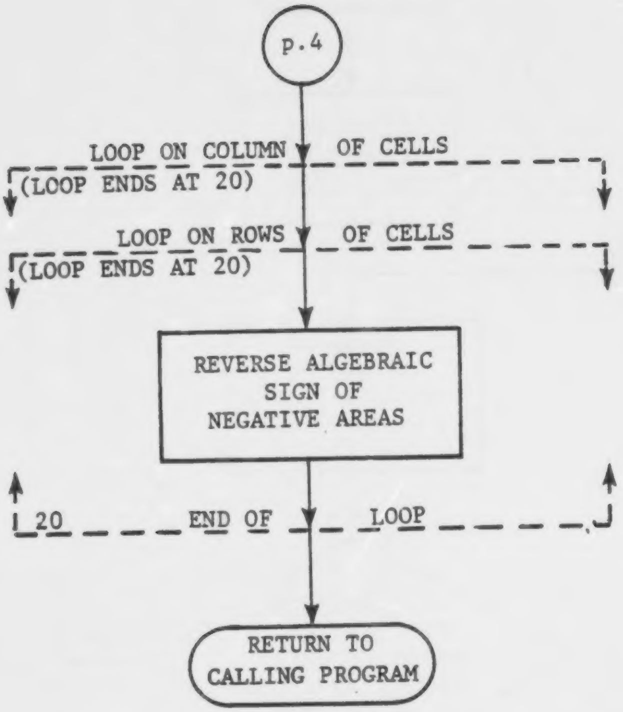

p.3
THE ALGEBRAIC SIGN OF ROW INDEX INCREMENT IS SAME AS SIGN OF CHANGE IN COLUMN INDEX
14
MOVE TO NEXT CELL ON THIS COLUMN
IS THIS CELL WITHIN CONTAINING RECTANGLE FOR THIS COUNTY
NO
YES
IS CELL EXTERIOR
YES
SET CELL INTERIOR
IS CELL BOUNDARY
NO
YES
15
MOVE TO BEGINNING POINT ON COLUMN
p.4

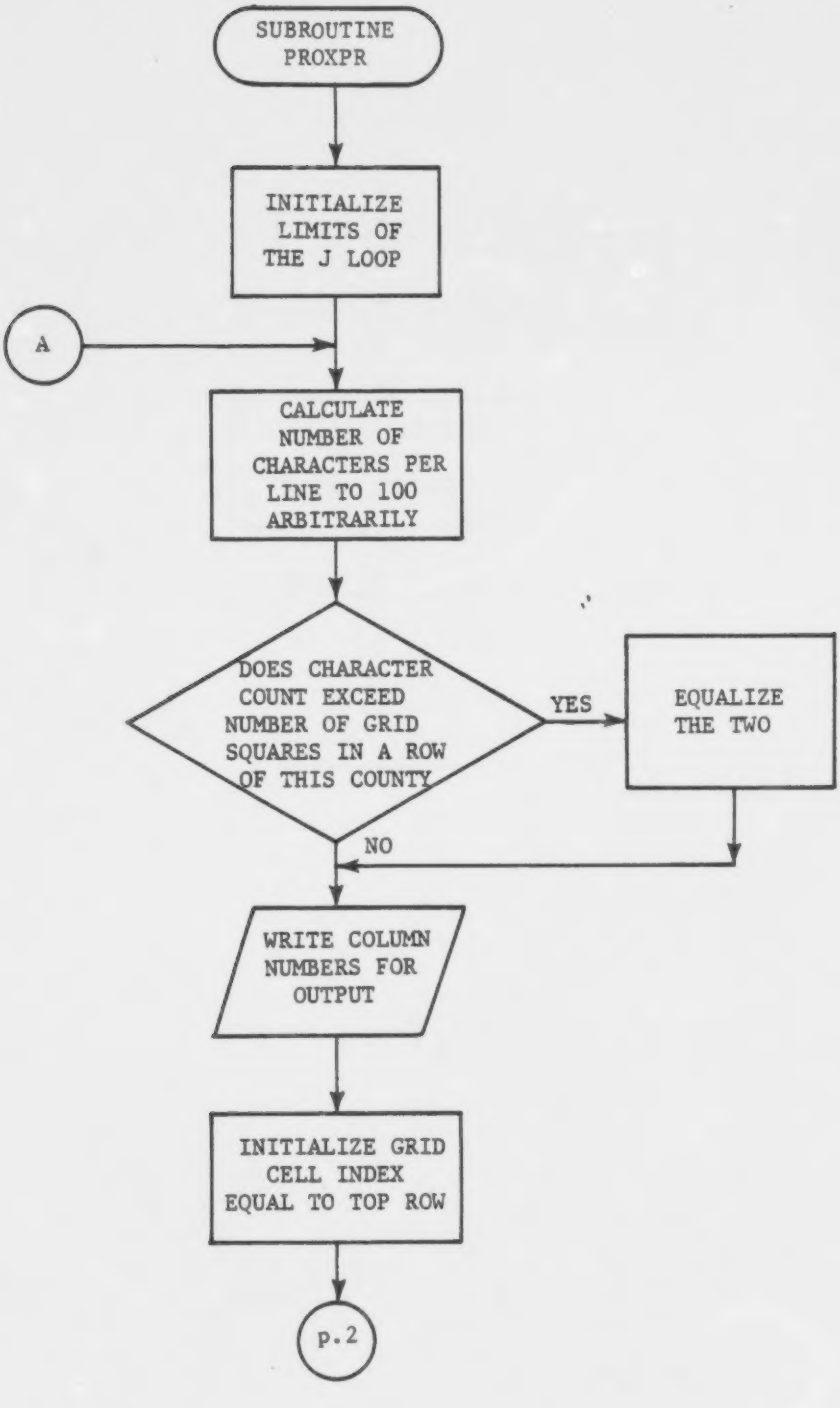

p.4
16
MOVE TO NEXT CELL ON THIS COLUMN
IS THIS CELL WITHIN CONTAINING RECTANGLE FOR THIS COUNTY
NO
RETURN TO CALLING PROGRAM
YES
IS CELL INTERIOR
YES
SET CELL EXTERIOR
NO
IS CELL BOUNDARY
NO
YES
RETURN TO CALLING PROGRAM

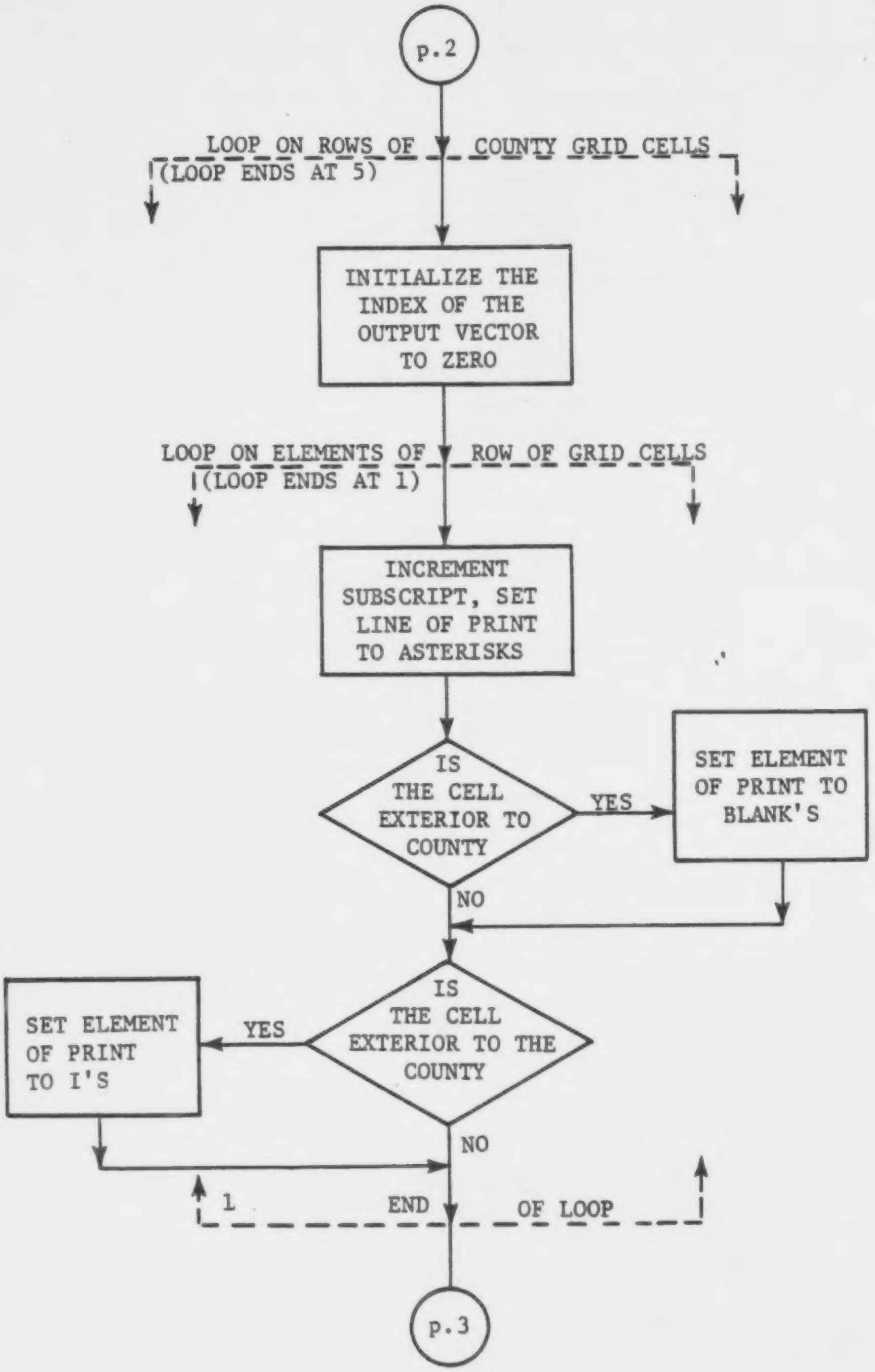

SUBROUTINE FINAL
INITIALIZE LIMITS OF LOOP INDEX
LOOP ON ROW OF CONTAINING RECTANGLE
(LOOP ENDS AT 30)
LOOP ON COLUMN OF CONTAINING RECTANGLE
(LOOP ENDS AT 30)
IS THIS CELL BOUNDARY OR INTERIOR
YES
NO
ARE ANY OF THE 4 ADJOINING CELLS INTERIOR
YES
SET THIS CELL INTERIOR
NO
30 END OF LOOP
p.2

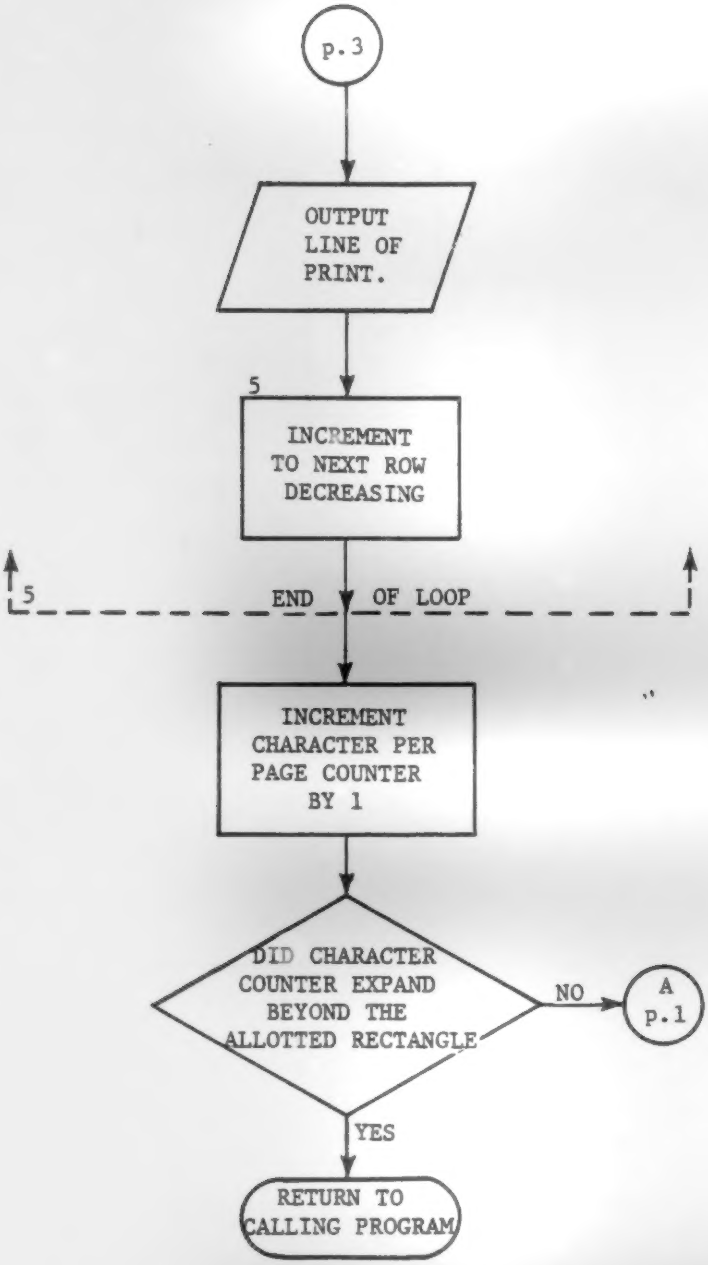

p.2
CONTAINING RECTANGLE
(LOOP ENDS AT 1)
LOOP ON COLUMN OF CONTAINING RECTANGLE
(LOOP ENDS AT 2)
IS CELL A BOUNDARY CELL
YES
NO
2
SET CELL EXTERIOR
END OF LOOP
3
MOVE TO OPPOSITE SIDE OF RECTANGLE
LOOP ON COLUMN OF CONTAINED ARRAY
(LOOP ENDS AT 4)
IS CELL A BOUNDARY CELL
YES
NO
SET CELL EXTERIOR
4
CHANGE COLUMN INDEX
END OF LOOP
1
END OF LOOP
p.3

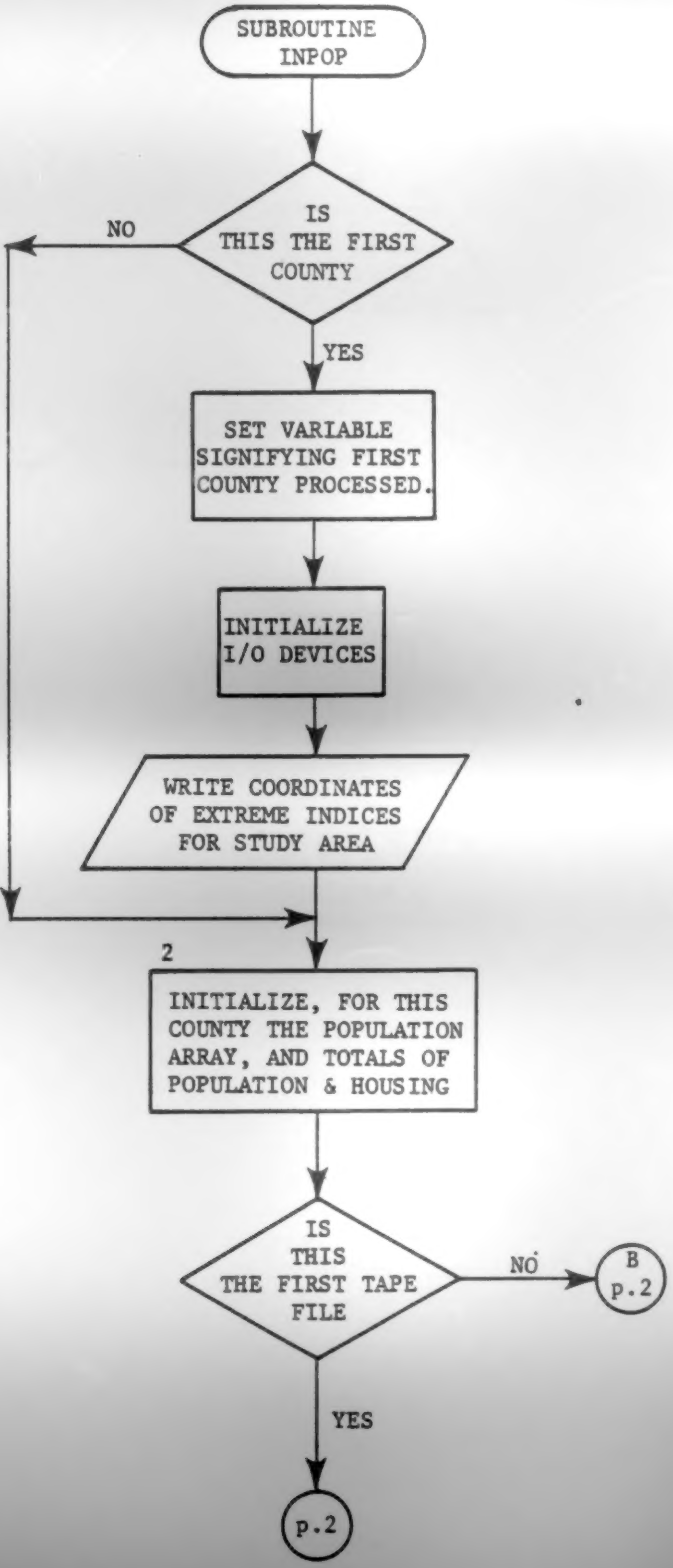

p.3
LOOP ON COLUMNS OF CELLS
(LOOP ENDS AT 9)
LOOP ON ROWS OF CELLS
(LOOP ENDS AT 5)
IS CELL A BOUNDARY CELL ?
YES
NO
5
CELL IS EXTERIOR. SET ITS AREA TO ZERO.
END OF LOOP
6
REVERSE THE DIRECTION OF THE I (ROW) LOOP
LOOP ON ROWS OF CELLS
(LOOP ENDS AT 7)
IS CELL A BOUNDARY CELL ?
YES
NO
CELL IS EXTERIOR. SET ITS AREA TO ZERO.
7
DECREASE I (ROW) INDEX-NEXT ROW
END OF LOOP
9
END OF LOOP
p.4

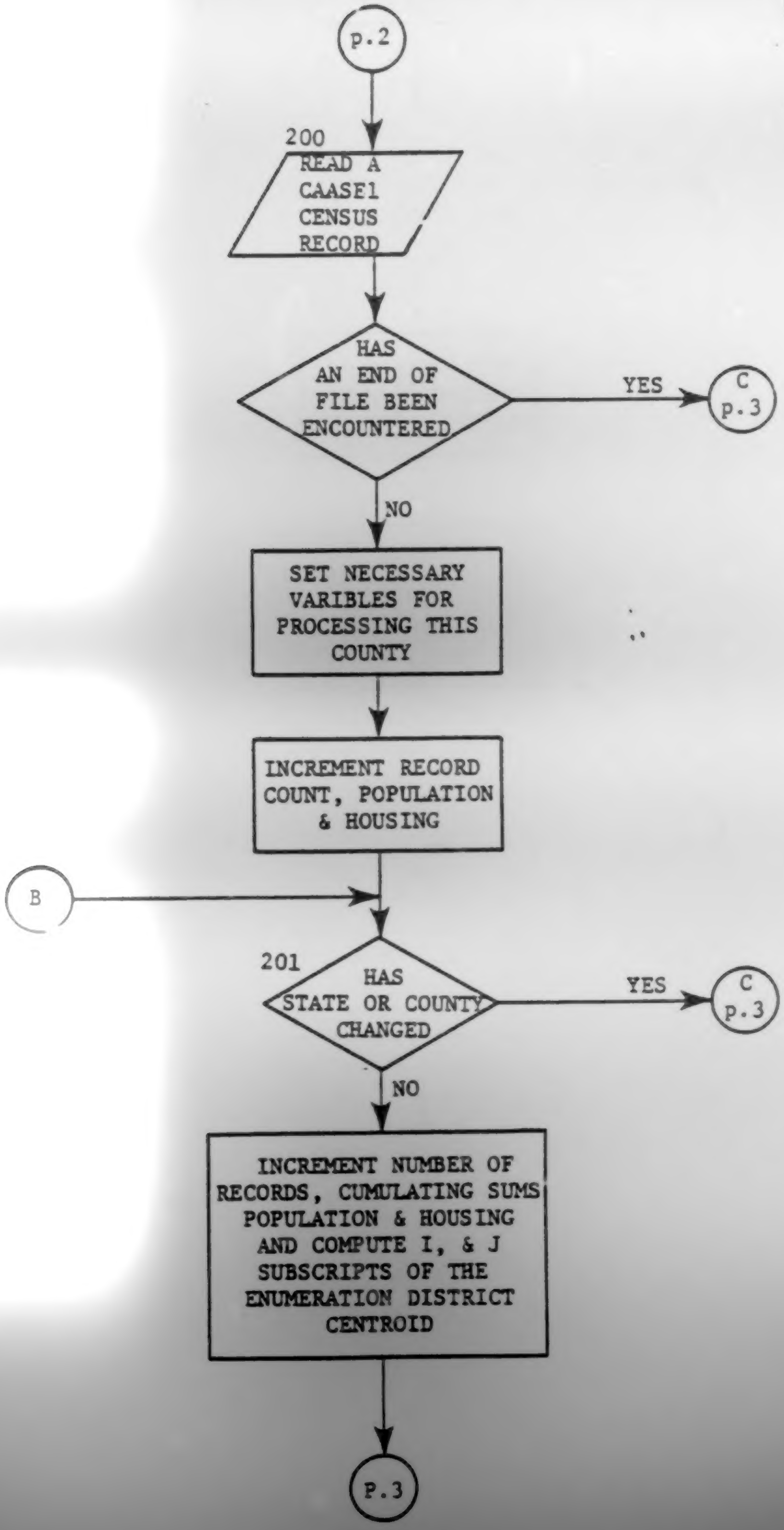

p.4
LOOP ON COLUMN OF CELLS
(LOOP ENDS AT 20)
LOOP ON ROWS OF CELLS
(LOOP ENDS AT 20)
REVERSE ALGEBRAIC SIGN OF NEGATIVE AREAS
20 END OF LOOP
RETURN TO CALLING PROGRAM

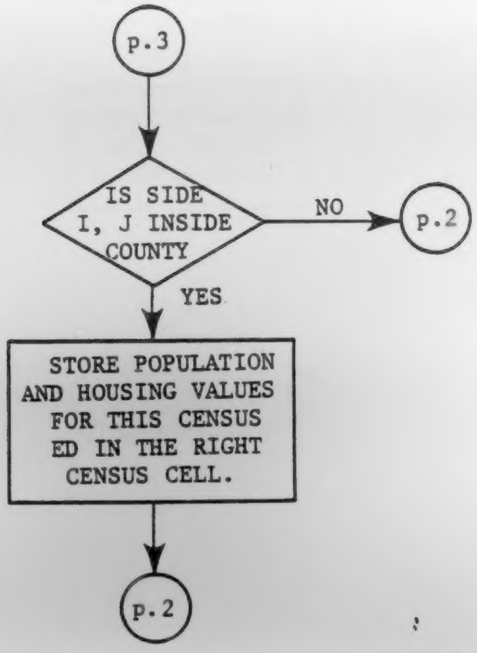

SUBROUTINE PROXPR
INITIALIZE LIMITS OF THE J LOOP
A
CALCULATE NUMBER OF CHARACTERS PER LINE TO 100 ARBITRARILY
DOES CHARACTER COUNT EXCEED NUMBER OF GRID SQUARES IN A ROW OF THIS COUNTY
YES
EQUALIZE THE TWO
NO
WRITE COLUMN NUMBERS FOR OUTPUT
INITIALIZE GRID CELL INDEX EQUAL TO TOP ROW
p.2

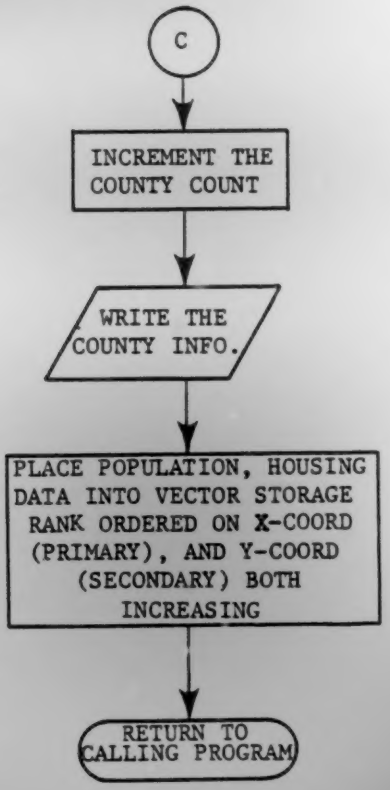

p.2
LOOP ON ROWS OF COUNTY GRID CELLS
(LOOP ENDS AT 5)
INITIALIZE THE INDEX OF THE OUTPUT VECTOR TO ZERO
LOOP ON ELEMENTS OF ROW OF GRID CELLS
(LOOP ENDS AT 1)
INCREMENT SUBSCRIPT, SET LINE OF PRINT TO ASTERISKS
IS THE CELL EXTERIOR TO COUNTY
YES
SET ELEMENT OF PRINT TO BLANK'S
NO
IS THE CELL EXTERIOR TO THE COUNTY
YES
SET ELEMENT OF PRINT TO I'S
NO
1
END OF LOOP
p.3

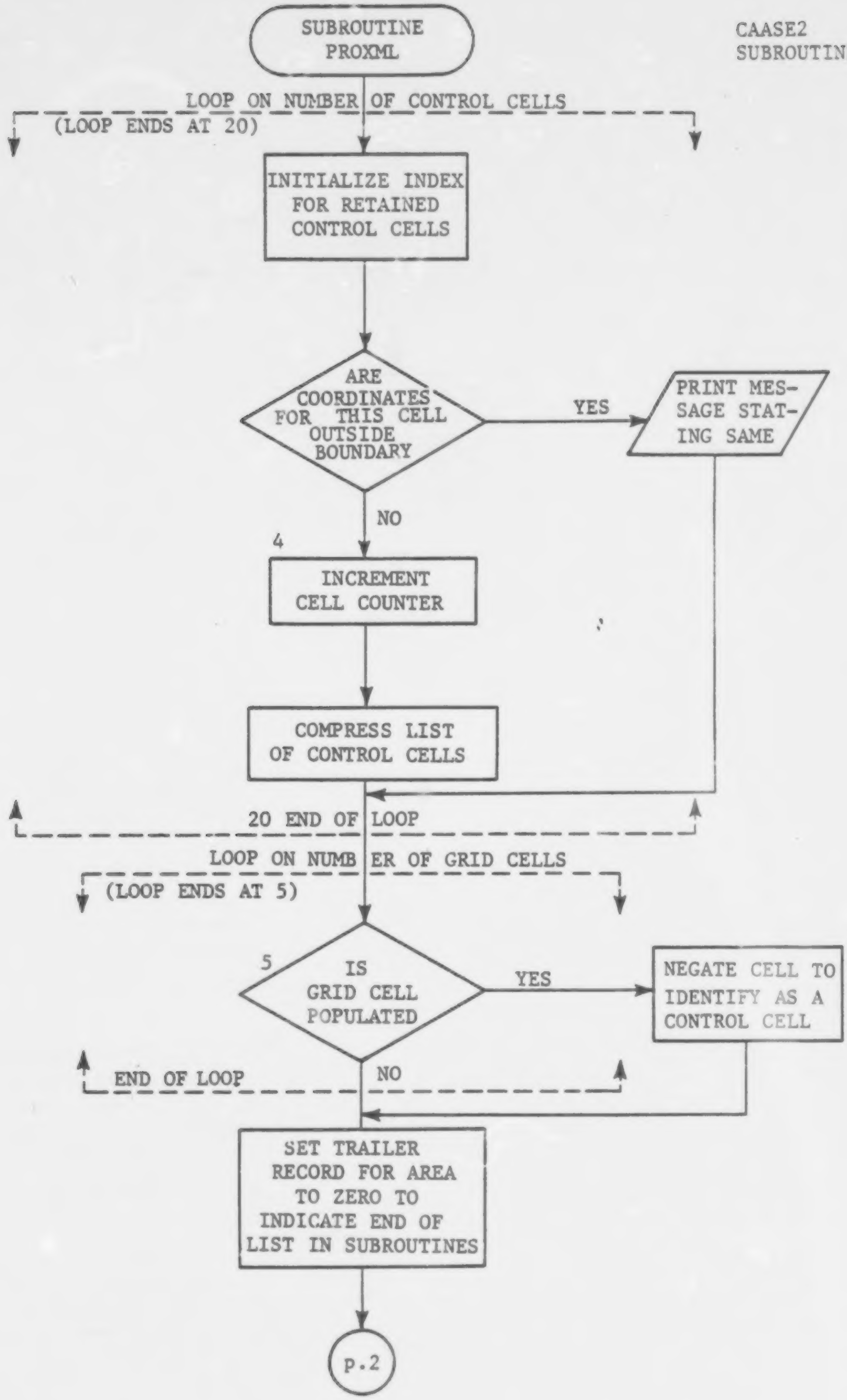

p.3
OUTPUT LINE OF PRINT.
5
INCREMENT TO NEXT ROW DECREASING
5
END OF LOOP
INCREMENT CHARACTER PER PAGE COUNTER BY 1
DID CHARACTER COUNTER EXPAND BEYOND THE ALLOTTED RECTANGLE
NO
A p.1
YES
RETURN TO CALLING PROGRAM

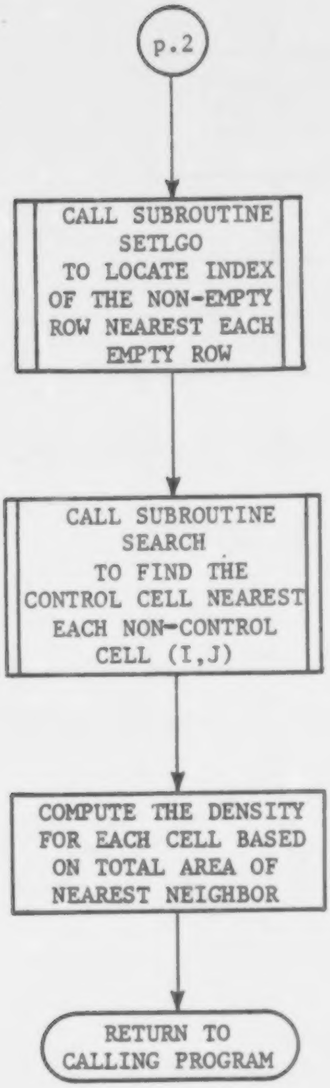

SUBROUTINE INPOP
IS THIS THE FIRST COUNTY
NO
YES
SET VARIABLE SIGNIFYING FIRST COUNTY PROCESSED.
INITIALIZE I/O DEVICES
WRITE COORDINATES OF EXTREME INDICES FOR STUDY AREA
2
INITIALIZE, FOR THIS COUNTY THE POPULATION ARRAY, AND TOTALS OF POPULATION & HOUSING
IS THIS THE FIRST TAPE FILE
NO
B p.2
YES
p.2

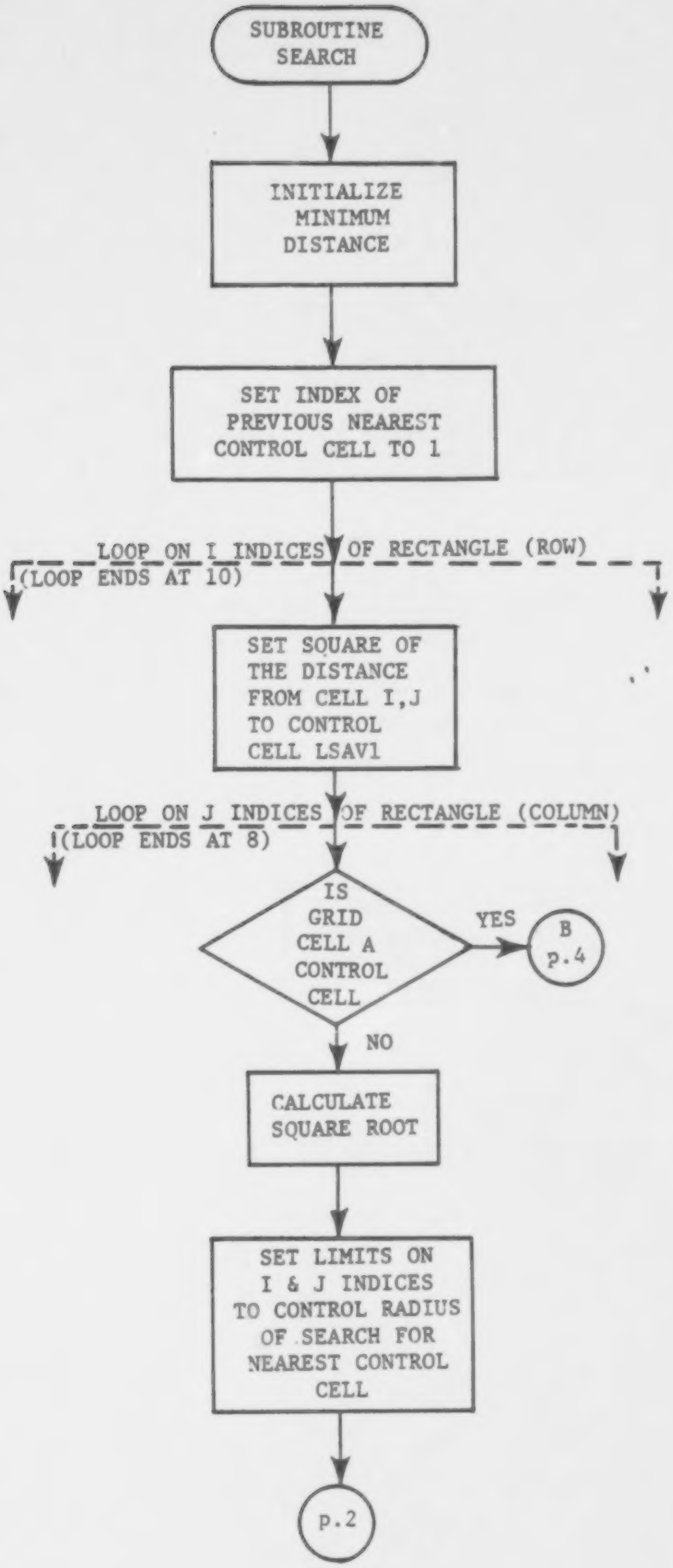

p.2
200
READ A CAASE1 CENSUS RECORD
HAS AN END OF FILE BEEN ENCOUNTERED
YES
C p.3
NO
SET NECESSARY VARIBLES FOR PROCESSING THIS COUNTY
INCREMENT RECORD COUNT, POPULATION & HOUSING
B
201
HAS STATE OR COUNTY CHANGED
YES
C p.3
NO
INCREMENT NUMBER OF RECORDS, CUMULATING SUMS POPULATION & HOUSING AND COMPUTE I, & J SUBSCRIPTS OF THE ENUMERATION DISTRICT CENTROID
P.3

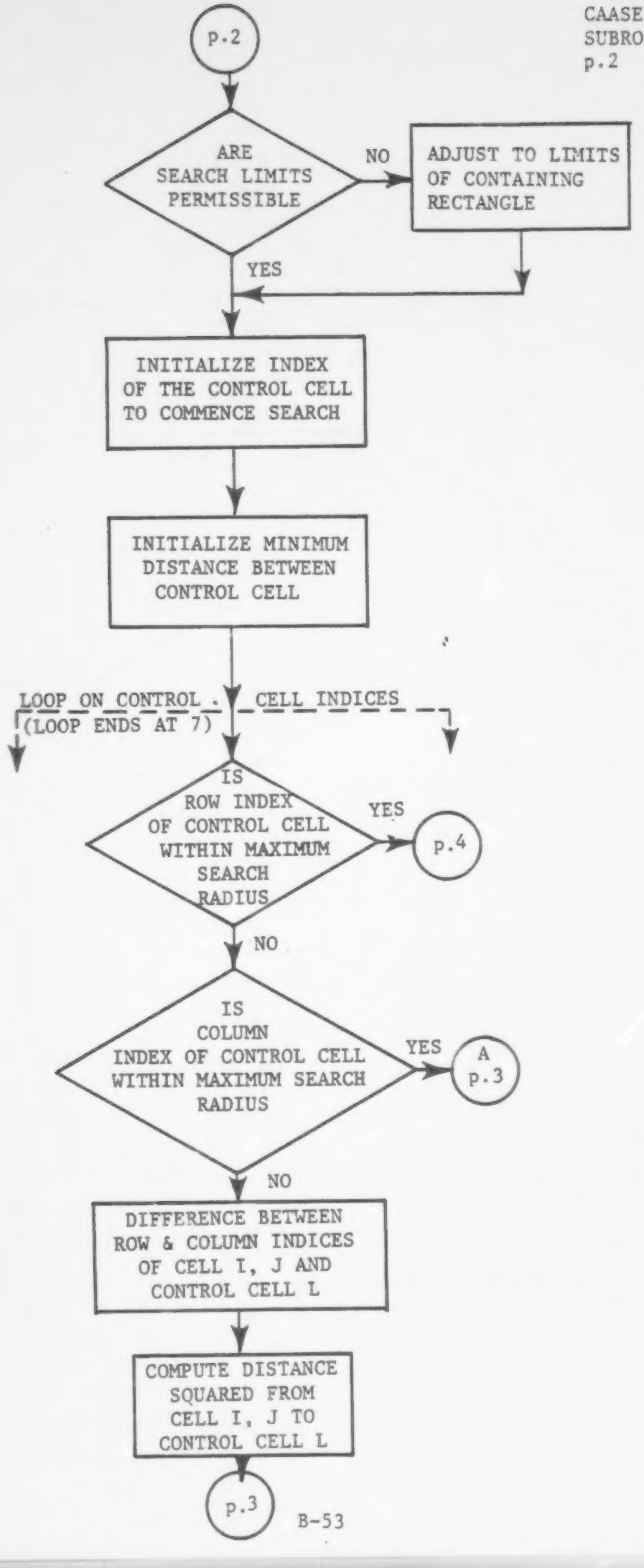

p.3
IS SIDE I, J INSIDE COUNTY
NO
p.2
YES
STORE POPULATION AND HOUSING VALUES FOR THIS CENSUS ED IN THE RIGHT CENSUS CELL.
p.2

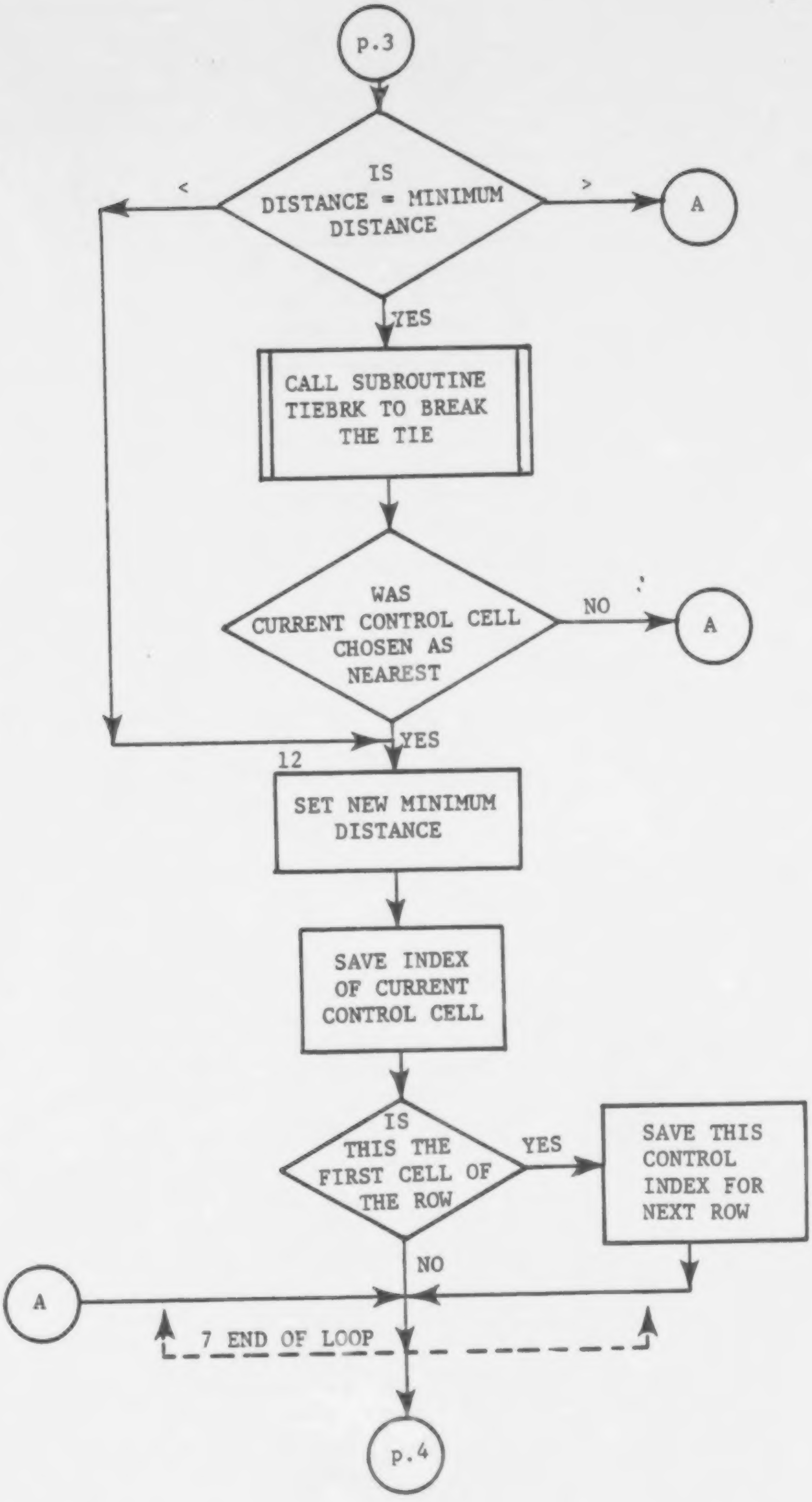

C
INCREMENT THE COUNTY COUNT
WRITE THE COUNTY INFO.
PLACE POPULATION, HOUSING DATA INTO VECTOR STORAGE RANK ORDERED ON X-COORD (PRIMARY), AND Y-COORD (SECONDARY) BOTH INCREASING
RETURN TO CALLING PROGRAM

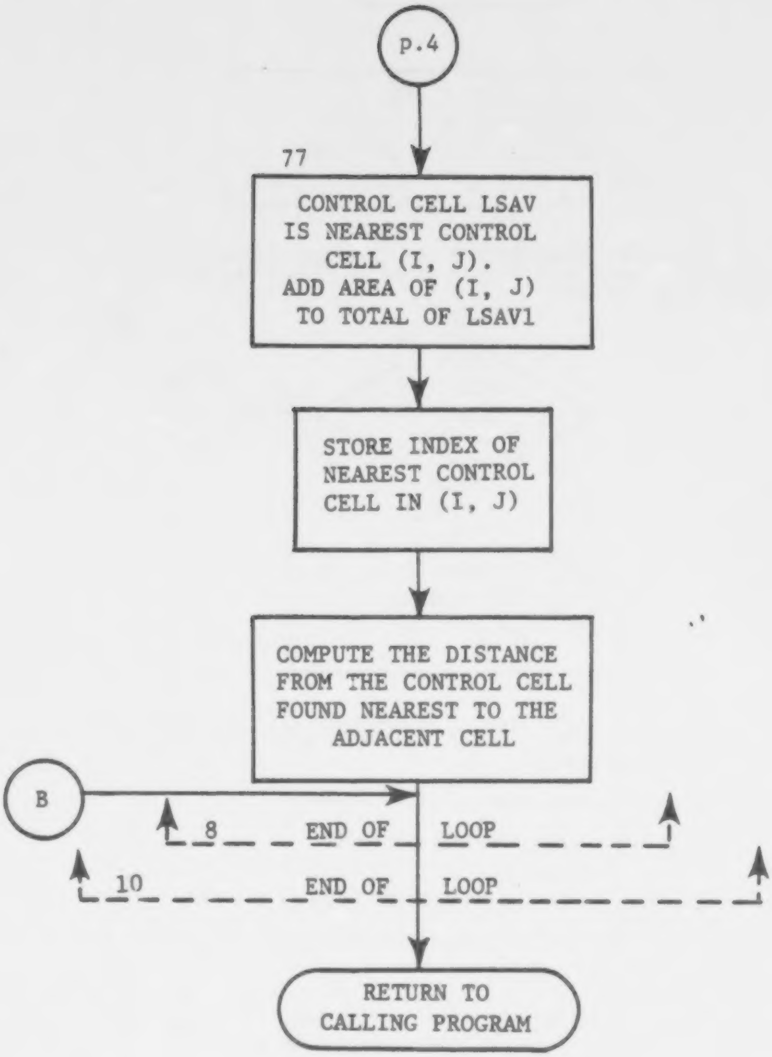

SUBROUTINE PROXML
LOOP ON NUMBER OF CONTROL CELLS
(LOOP ENDS AT 20)
INITIALIZE INDEX FOR RETAINED CONTROL CELLS
ARE COORDINATES FOR THIS CELL OUTSIDE BOUNDARY
YES
PRINT MESSAGE STATING SAME
NO
4
INCREMENT CELL COUNTER
COMPRESS LIST OF CONTROL CELLS
20 END OF LOOP
LOOP ON NUMBER OF GRID CELLS
(LOOP ENDS AT 5)
5
IS GRID CELL POPULATED
YES
NEGATE CELL TO IDENTIFY AS A CONTROL CELL
NO
END OF LOOP
SET TRAILER RECORD FOR AREA TO ZERO TO INDICATE END OF LIST IN SUBROUTINES
p.2

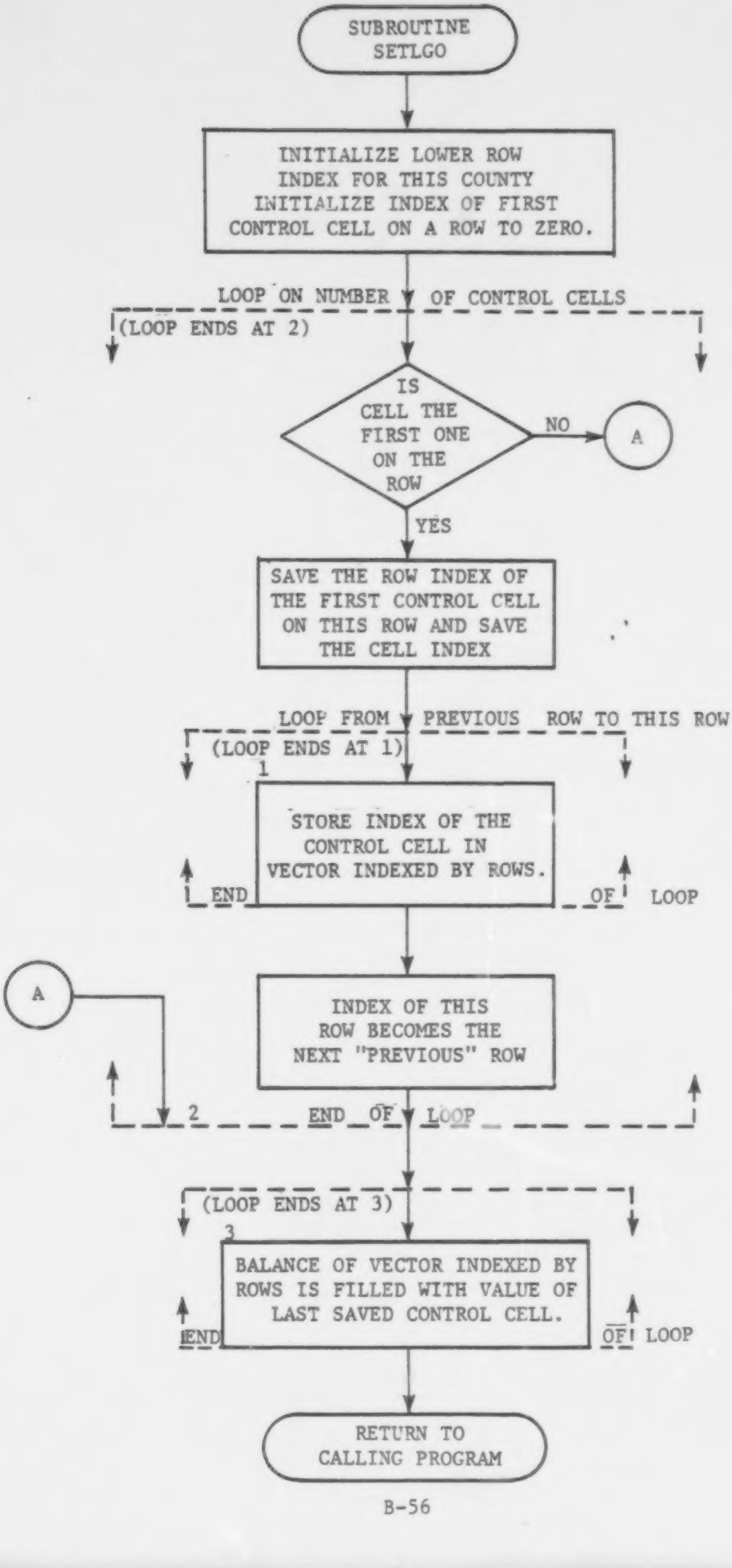

p.2
CALL SUBROUTINE SETLGO TO LOCATE INDEX OF THE NON-EMPTY ROW NEAREST EACH EMPTY ROW
CALL SUBROUTINE SEARCH TO FIND THE CONTROL CELL NEAREST EACH NON-CONTROL CELL (I,J)
COMPUTE THE DENSITY FOR EACH CELL BASED ON TOTAL AREA OF NEAREST NEIGHBOR
RETURN TO CALLING PROGRAM

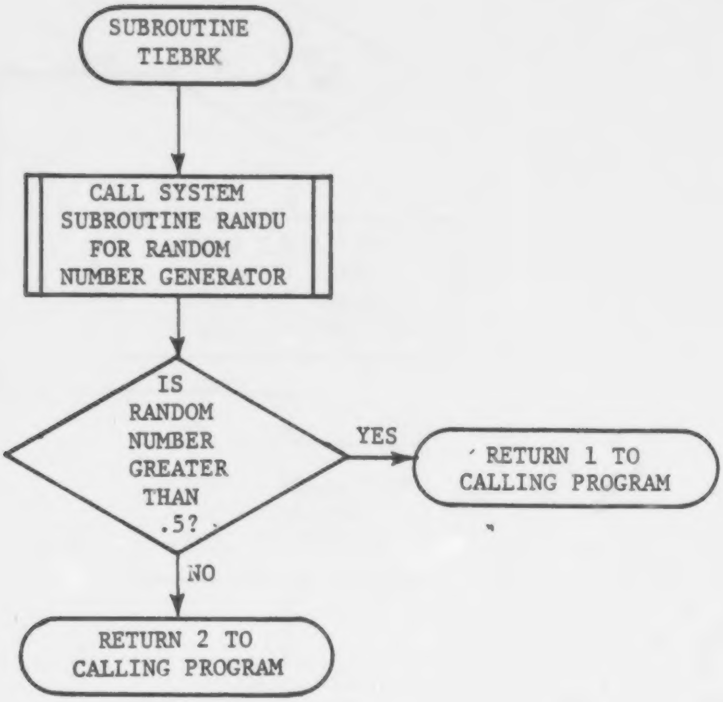

SUBROUTINE SEARCH
INITIALIZE MINIMUM DISTANCE
SET INDEX OF PREVIOUS NEAREST CONTROL CELL TO 1
LOOP ON I INDICES OF RECTANGLE (ROW)
(LOOP ENDS AT 10)
SET SQUARE OF THE DISTANCE FROM CELL I,J TO CONTROL CELL LSAV1
LOOP ON J INDICES OF RECTANGLE (COLUMN)
(LOOP ENDS AT 8)
IS GRID CELL A CONTROL CELL
YES
B
p.4
NO
CALCULATE SQUARE ROOT
SET LIMITS ON I & J INDICES TO CONTROL RADIUS OF SEARCH FOR NEAREST CONTROL CELL
p.2

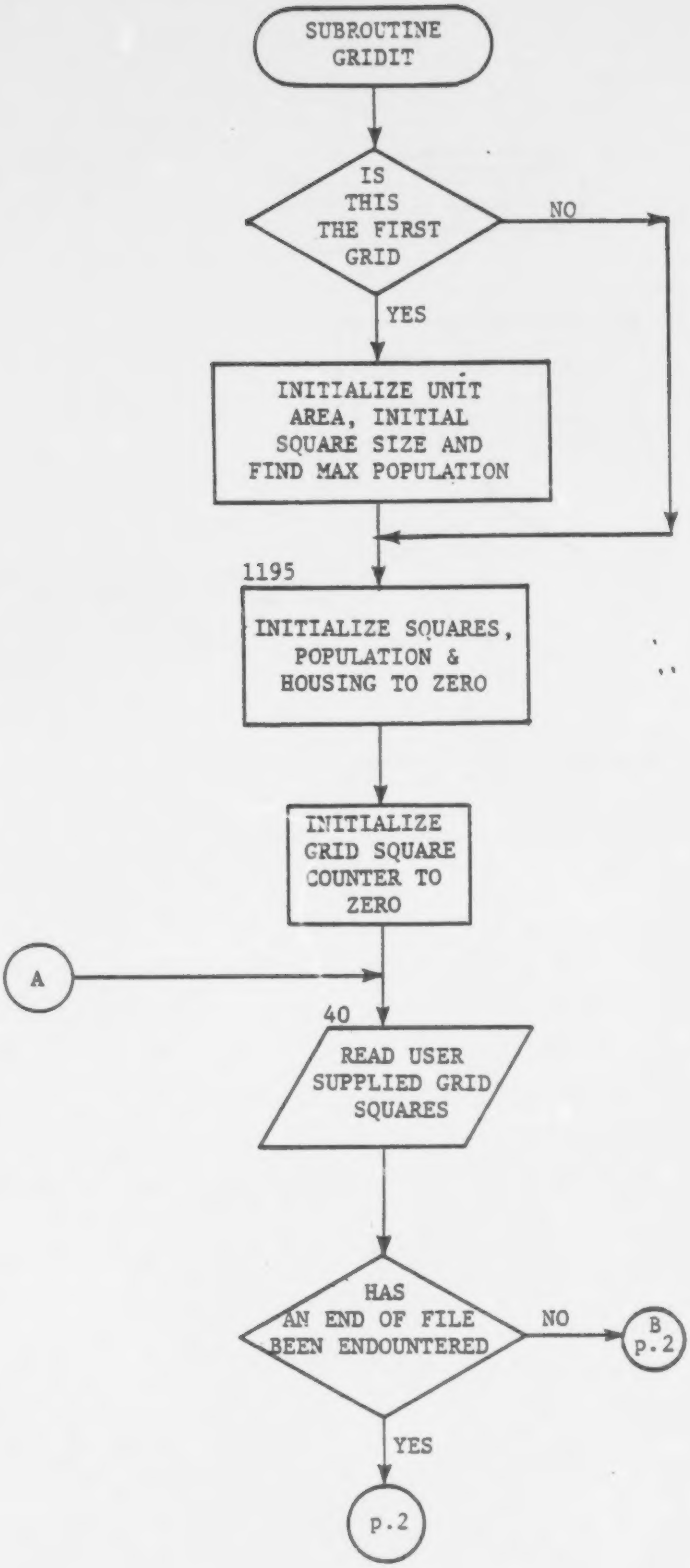

p.2
ARE SEARCH LIMITS PERMISSIBLE
NO
ADJUST TO LIMITS OF CONTAINING RECTANGLE
YES
INITIALIZE INDEX OF THE CONTROL CELL TO COMMENCE SEARCH
INITIALIZE MINIMUM DISTANCE BETWEEN CONTROL CELL
LOOP ON CONTROL CELL INDICES
(LOOP ENDS AT 7)
IS ROW INDEX OF CONTROL CELL WITHIN MAXIMUM SEARCH RADIUS
YES
p.4
NO
IS COLUMN INDEX OF CONTROL CELL WITHIN MAXIMUM SEARCH RADIUS
YES
A p.3
NO
DIFFERENCE BETWEEN ROW & COLUMN INDICES OF CELL I, J AND CONTROL CELL L
COMPUTE DISTANCE SQUARED FROM CELL I, J TO CONTROL CELL L
p.3

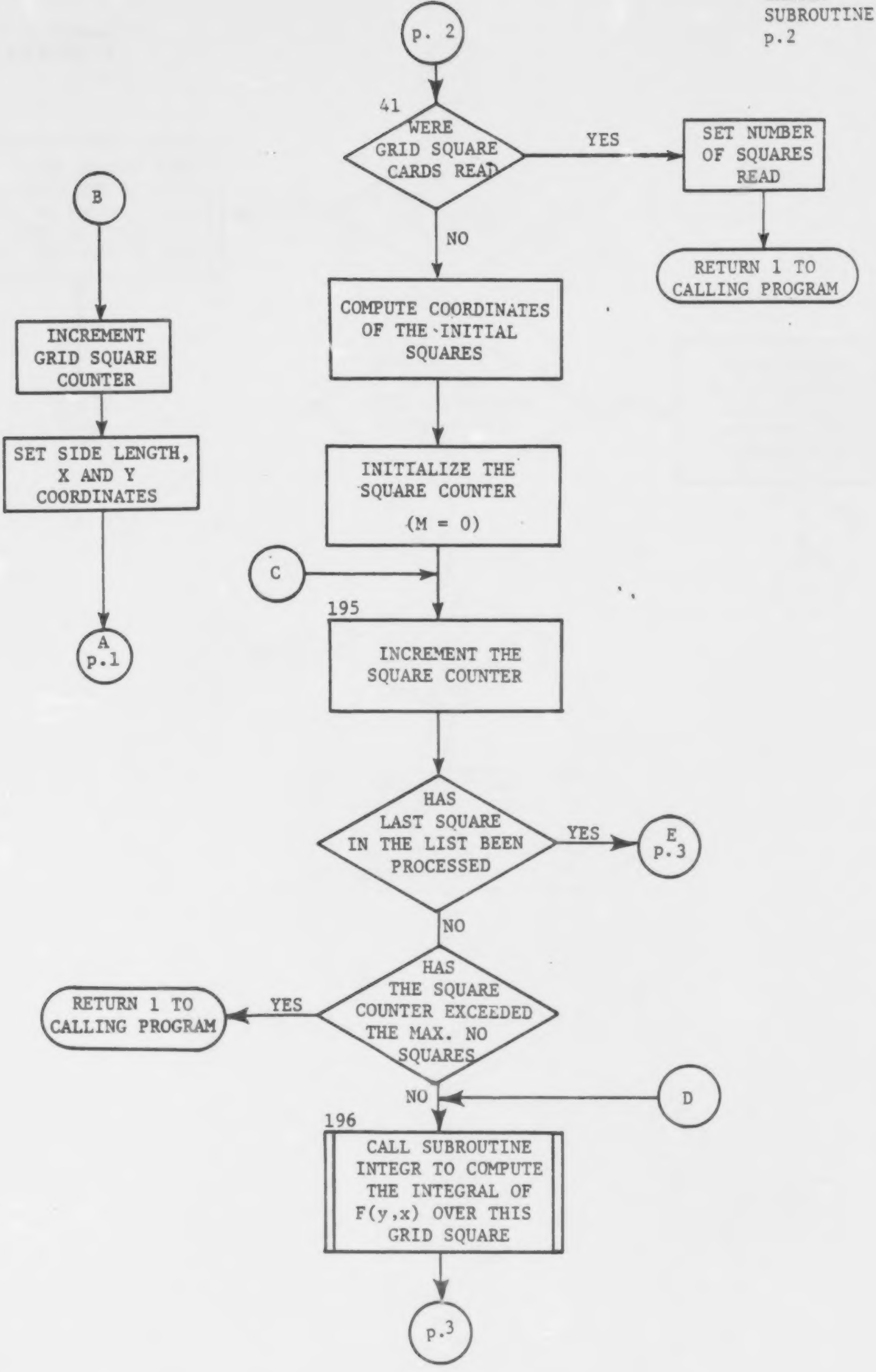

p.3
IS DISTANCE = MINIMUM DISTANCE
<
>
A
YES
CALL SUBROUTINE TIEBRK TO BREAK THE TIE
WAS CURRENT CONTROL CELL CHOSEN AS NEAREST
NO
A
YES
12
SET NEW MINIMUM DISTANCE
SAVE INDEX OF CURRENT CONTROL CELL
IS THIS THE FIRST CELL OF THE ROW
YES
SAVE THIS CONTROL INDEX FOR NEXT ROW
NO
A
7 END OF LOOP
p.4

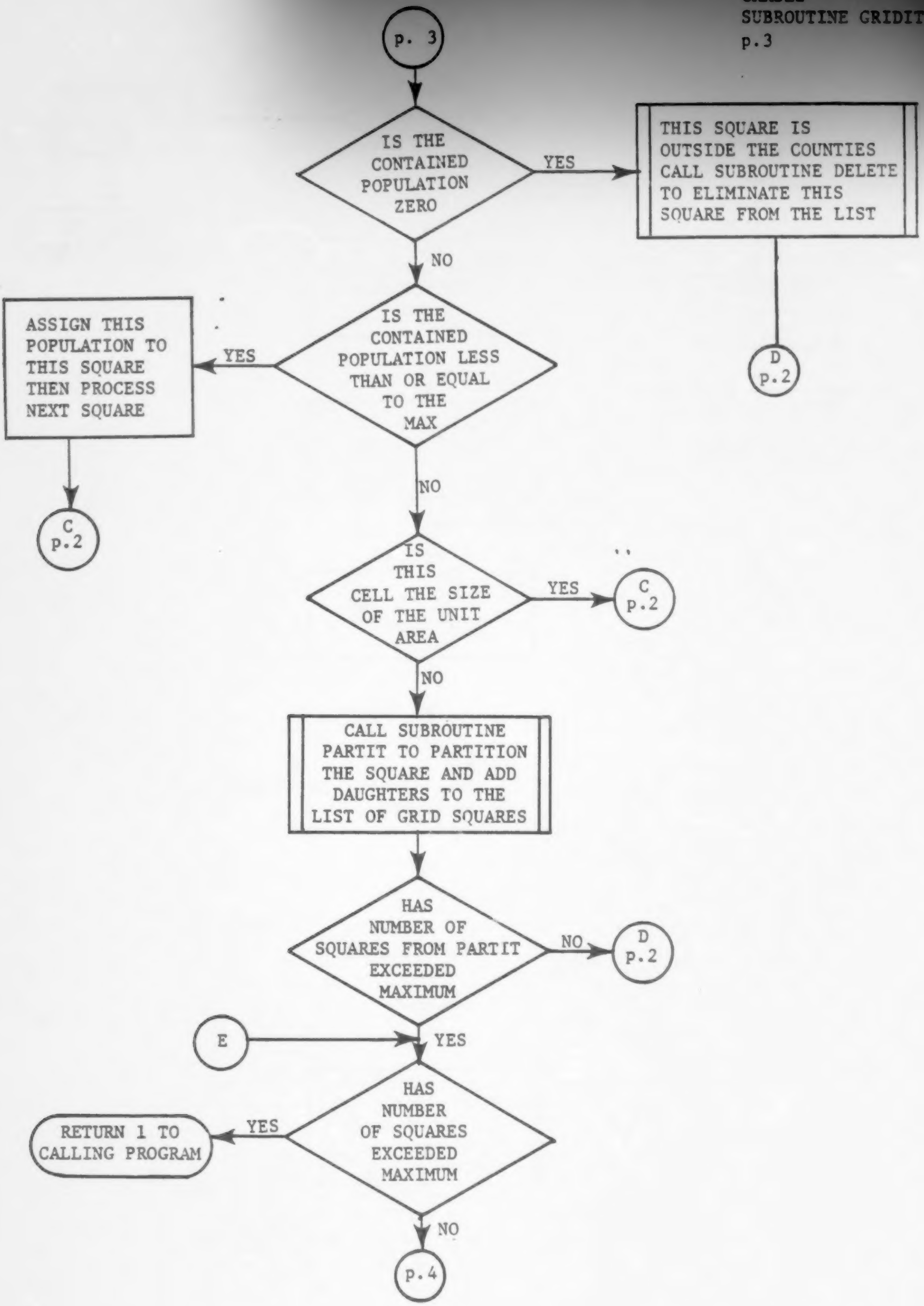

p.4
77
CONTROL CELL LSAV IS NEAREST CONTROL CELL (I, J). ADD AREA OF (I, J) TO TOTAL OF LSAV1
STORE INDEX OF NEAREST CONTROL CELL IN (I, J)
COMPUTE THE DISTANCE FROM THE CONTROL CELL FOUND NEAREST TO THE ADJACENT CELL
B
8 END OF LOOP
10 END OF LOOP
RETURN TO CALLING PROGRAM

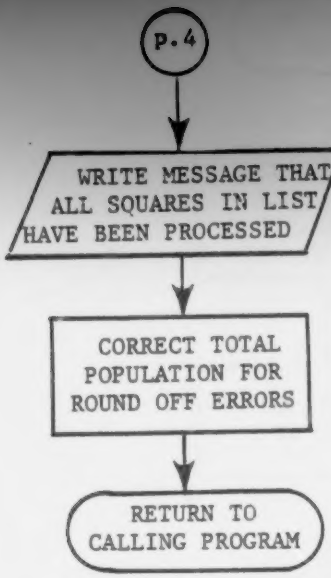

SUBROUTINE SETLGO
INITIALIZE LOWER ROW INDEX FOR THIS COUNTY INITIALIZE INDEX OF FIRST CONTROL CELL ON A ROW TO ZERO.
LOOP ON NUMBER OF CONTROL CELLS
(LOOP ENDS AT 2)
IS CELL THE FIRST ONE ON THE ROW
NO
A
YES
SAVE THE ROW INDEX OF THE FIRST CONTROL CELL ON THIS ROW AND SAVE THE CELL INDEX
LOOP FROM PREVIOUS ROW TO THIS ROW
(LOOP ENDS AT 1)
1
STORE INDEX OF THE CONTROL CELL IN VECTOR INDEXED BY ROWS.
END OF LOOP
A
INDEX OF THIS ROW BECOMES THE NEXT "PREVIOUS" ROW
2
END OF LOOP
(LOOP ENDS AT 3)
3
BALANCE OF VECTOR INDEXED BY ROWS IS FILLED WITH VALUE OF LAST SAVED CONTROL CELL.
END OF LOOP
RETURN TO CALLING PROGRAM

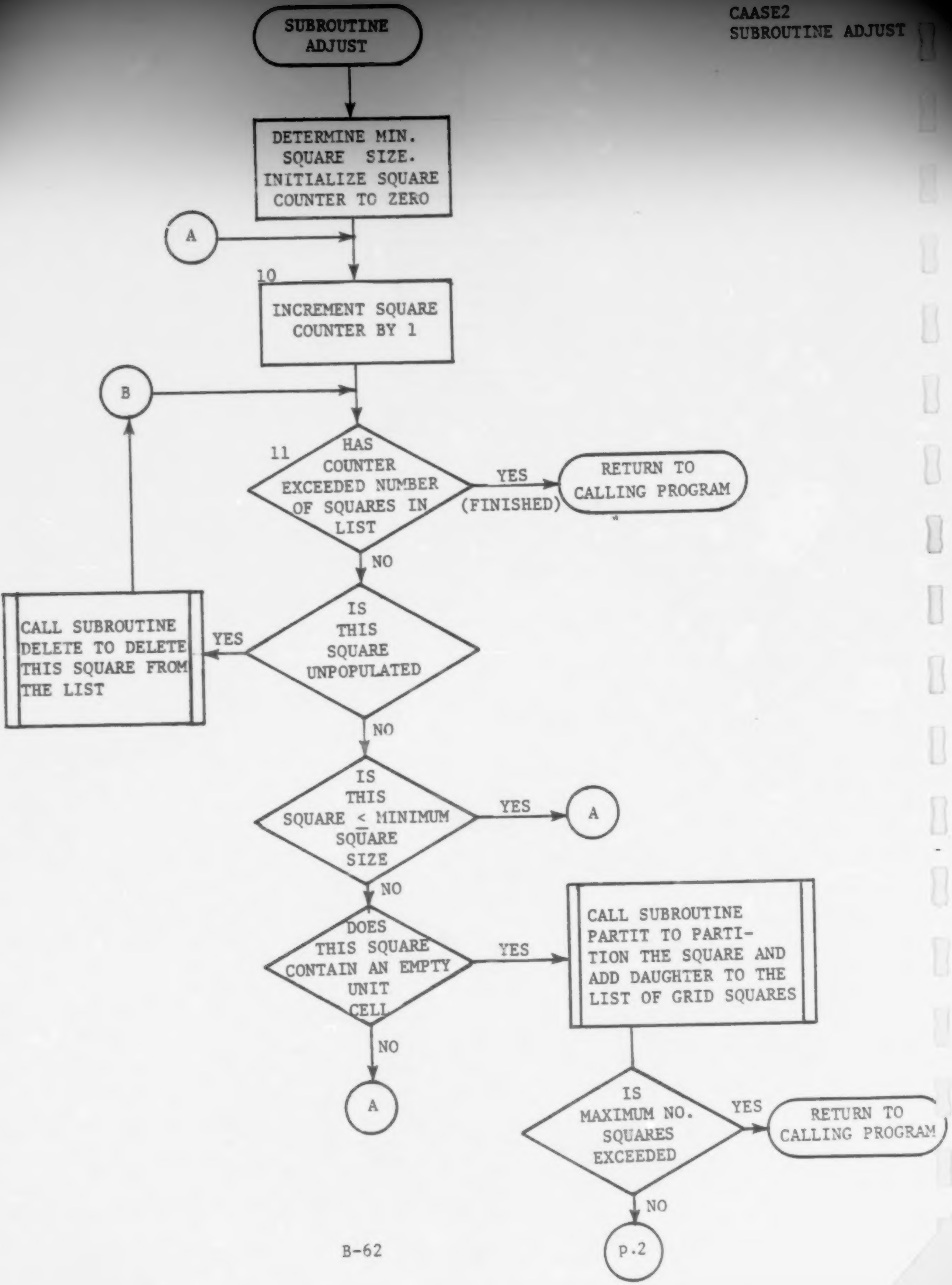

SUBROUTINE TIEBRK
CALL SYSTEM SUBROUTINE RANDU FOR RANDOM NUMBER GENERATOR
IS RANDOM NUMBER GREATER THAN .5?
YES
RETURN 1 TO CALLING PROGRAM
NO
RETURN 2 TO CALLING PROGRAM

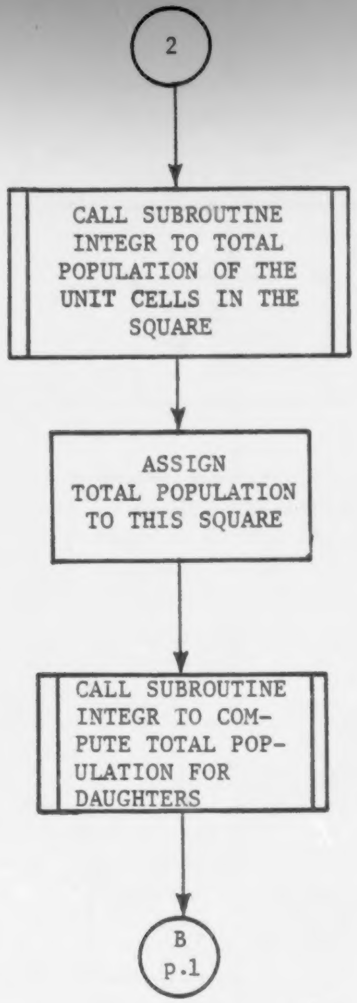

SUBROUTINE GRIDIT
IS THIS THE FIRST GRID
NO
YES
INITIALIZE UNIT AREA, INITIAL SQUARE SIZE AND FIND MAX POPULATION
1195
INITIALIZE SQUARES, POPULATION & HOUSING TO ZERO
INITIALIZE GRID SQUARE COUNTER TO ZERO
A
40
READ USER SUPPLIED GRID SQUARES
HAS AN END OF FILE BEEN ENDOUNTERED
NO
B p.2
YES
p.2


p. 2
41
WERE GRID SQUARE CARDS READ
YES
SET NUMBER OF SQUARES READ
RETURN 1 TO CALLING PROGRAM
NO
B
INCREMENT GRID SQUARE COUNTER
SET SIDE LENGTH, X AND Y COORDINATES
A p.1
COMPUTE COORDINATES OF THE INITIAL SQUARES
INITIALIZE THE SQUARE COUNTER (M = 0)
C
195
INCREMENT THE SQUARE COUNTER
HAS LAST SQUARE IN THE LIST BEEN PROCESSED
YES
E p.3
NO
HAS THE SQUARE COUNTER EXCEEDED THE MAX. NO SQUARES
YES
RETURN 1 TO CALLING PROGRAM
NO
D
196
CALL SUBROUTINE INTEGR TO COMPUTE THE INTEGRAL OF F(y,x) OVER THIS GRID SQUARE
p.3

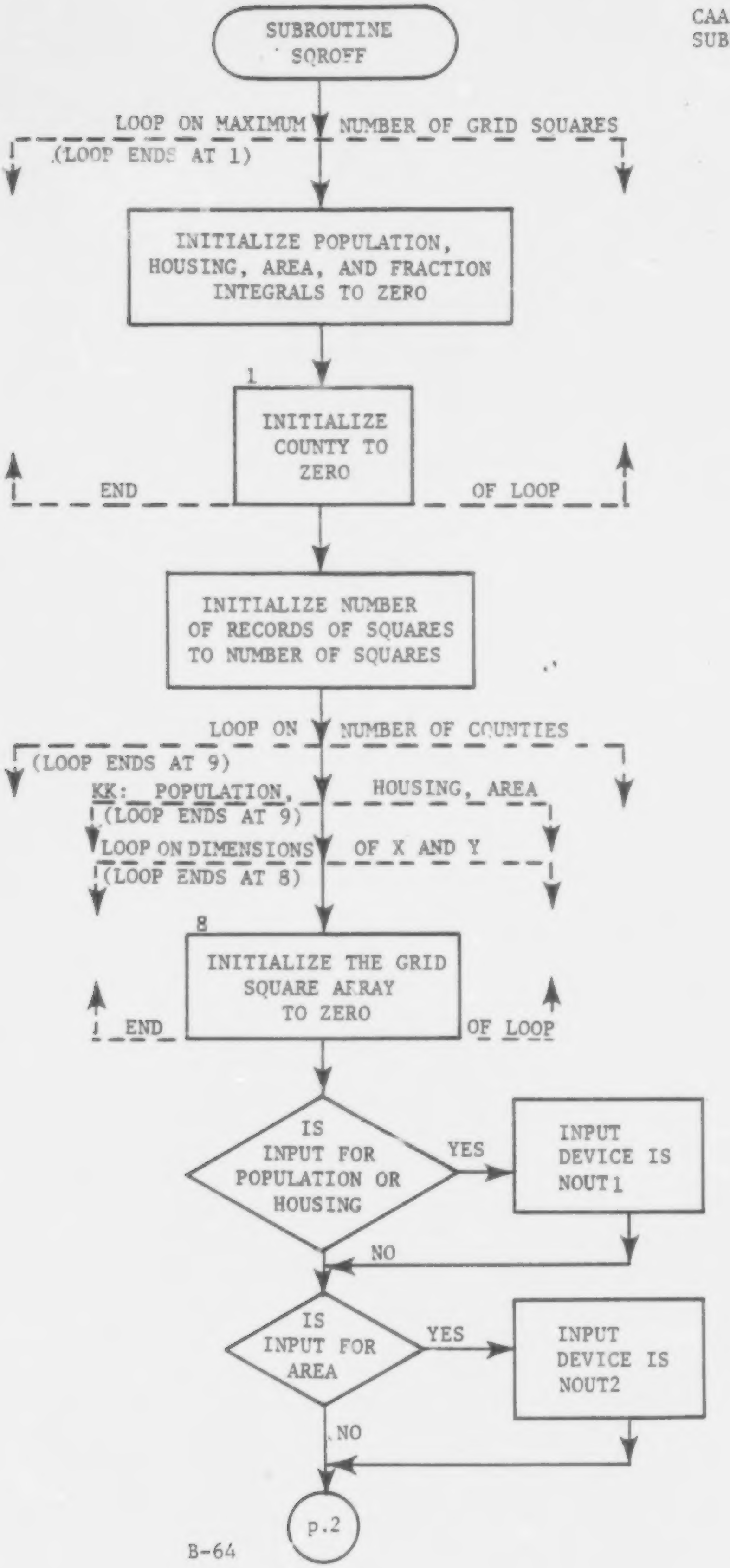

p. 3
IS THE CONTAINED POPULATION ZERO
YES
THIS SQUARE IS OUTSIDE THE COUNTIES CALL SUBROUTINE DELETE TO ELIMINATE THIS SQUARE FROM THE LIST
D p.2
NO
IS THE CONTAINED POPULATION LESS THAN OR EQUAL TO THE MAX
YES
ASSIGN THIS POPULATION TO THIS SQUARE THEN PROCESS NEXT SQUARE
C p.2
NO
IS THIS CELL THE SIZE OF THE UNIT AREA
YES
C p.2
NO
CALL SUBROUTINE PARTIT TO PARTITION THE SQUARE AND ADD DAUGHTERS TO THE LIST OF GRID SQUARES
HAS NUMBER OF SQUARES FROM PARTIT EXCEEDED MAXIMUM
NO
D p.2
E
YES
HAS NUMBER OF SQUARES EXCEEDED MAXIMUM
YES
RETURN 1 TO CALLING PROGRAM
NO
p.4


p.4
WRITE MESSAGE THAT ALL SQUARES IN LIST HAVE BEEN PROCESSED
CORRECT TOTAL POPULATION FOR ROUND OFF ERRORS
RETURN TO CALLING PROGRAM

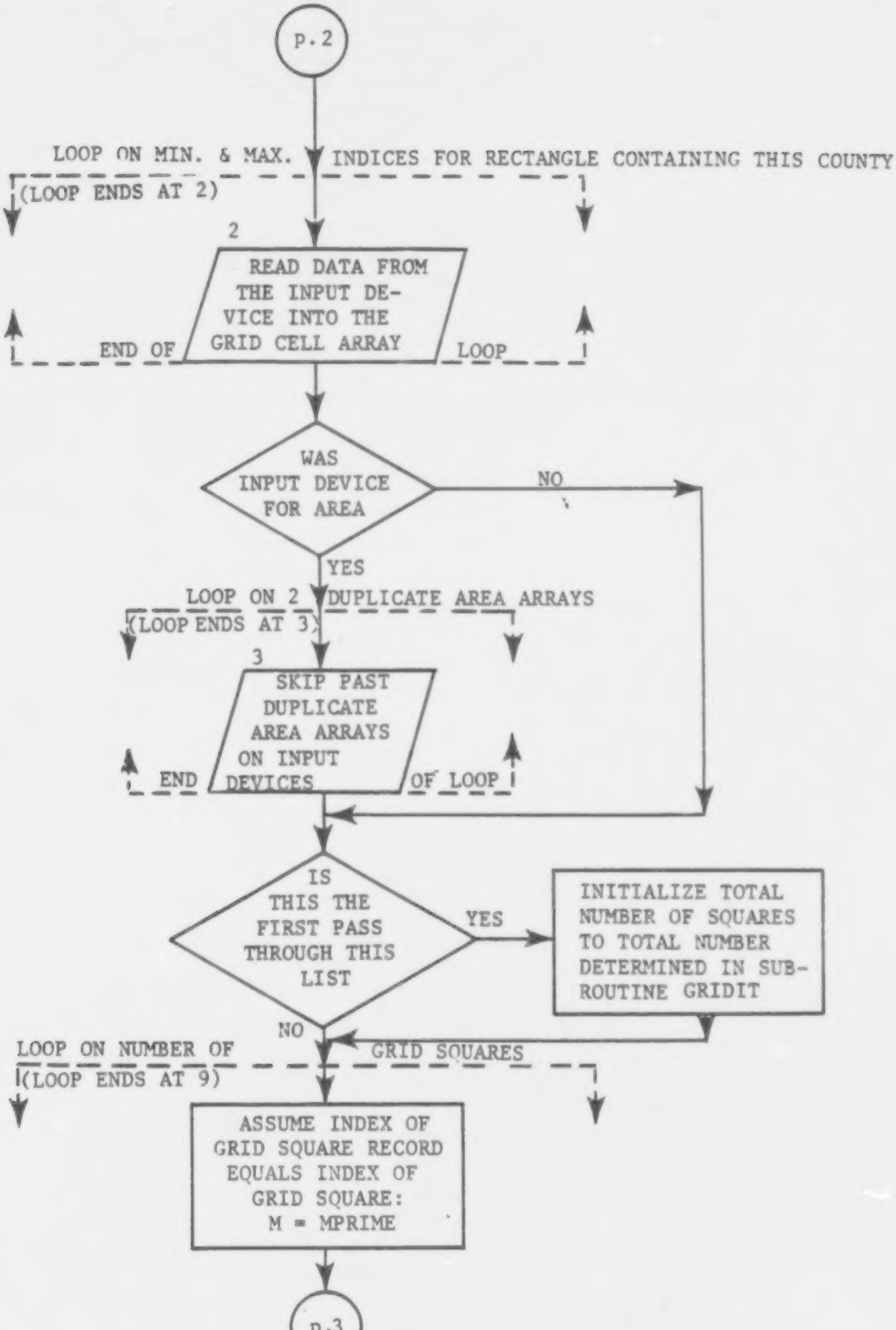

SUBROUTINE ADJUST
DETERMINE MIN. SQUARE SIZE. INITIALIZE SQUARE COUNTER TO ZERO
A
10
INCREMENT SQUARE COUNTER BY 1
B
11
HAS COUNTER EXCEEDED NUMBER OF SQUARES IN LIST
YES
(FINISHED)
RETURN TO CALLING PROGRAM
NO
IS THIS SQUARE UNPOPULATED
YES
CALL SUBROUTINE DELETE TO DELETE THIS SQUARE FROM THE LIST
NO
IS THIS SQUARE ≤ MINIMUM SQUARE SIZE
YES
A
NO
DOES THIS SQUARE CONTAIN AN EMPTY UNIT CELL
YES
CALL SUBROUTINE PARTIT TO PARTITION THE SQUARE AND ADD DAUGHTER TO THE LIST OF GRID SQUARES
NO
A
IS MAXIMUM NO. SQUARES EXCEEDED
YES
RETURN TO CALLING PROGRAM
NO
p.2

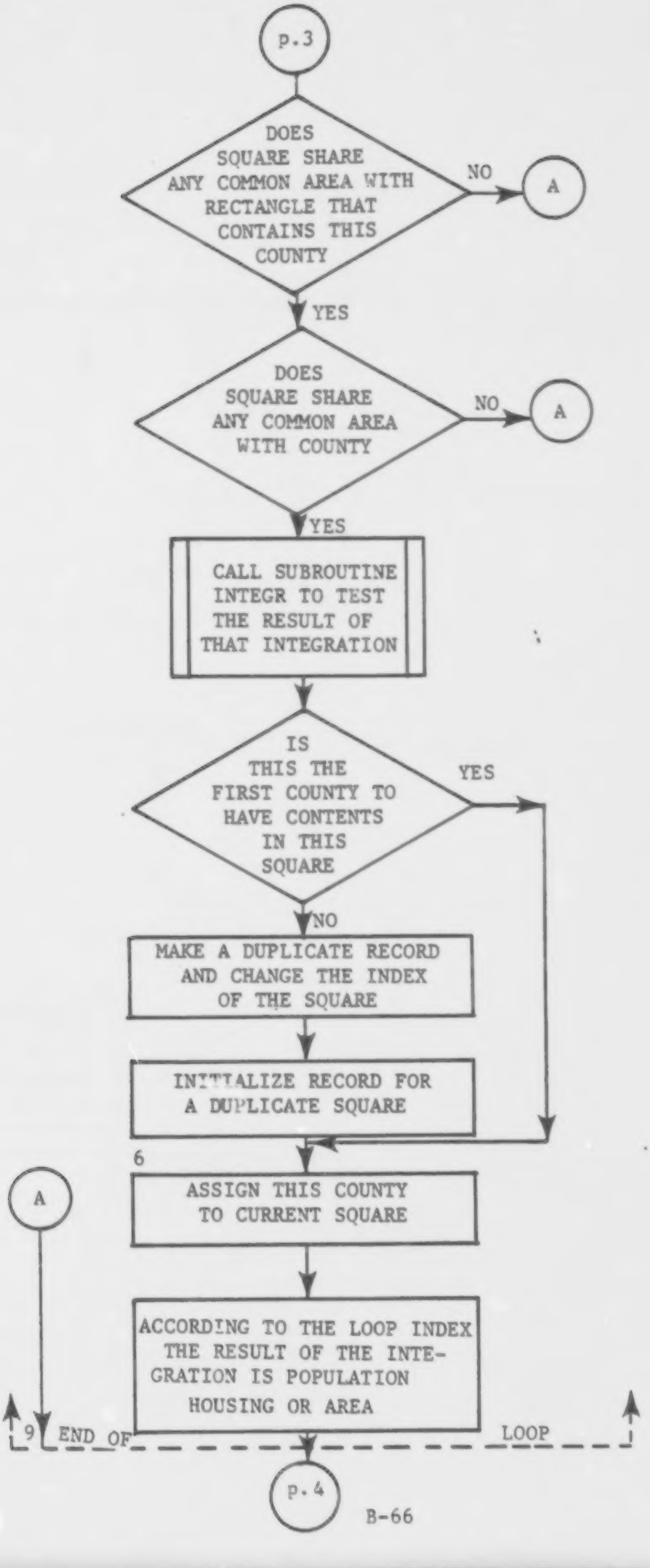

2
CALL SUBROUTINE INTEGR TO TOTAL POPULATION OF THE UNIT CELLS IN THE SQUARE
ASSIGN TOTAL POPULATION TO THIS SQUARE
CALL SUBROUTINE INTEGR TO COMPUTE TOTAL POPULATION FOR DAUGHTERS
B p.1

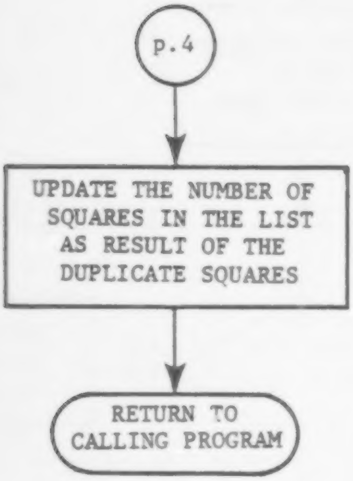
CAASE2
SUBROUTINE SOROFF

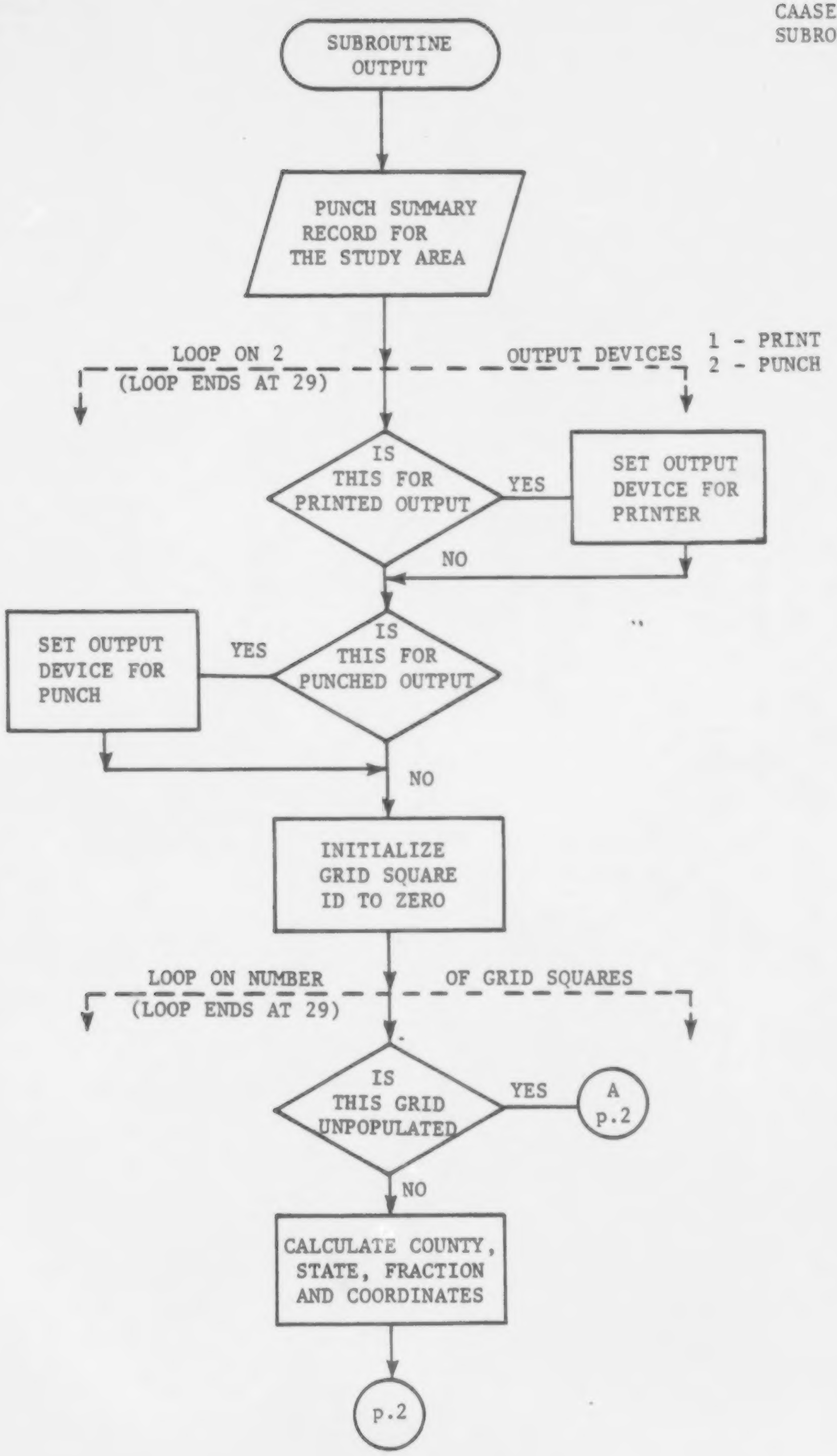

SUBROUTINE SOROFF
LOOP ON MAXIMUM NUMBER OF GRID SQUARES
(LOOP ENDS AT 1)
INITIALIZE POPULATION, HOUSING, AREA, AND FRACTION INTEGRALS TO ZERO
1
INITIALIZE COUNTY TO ZERO
END OF LOOP
INITIALIZE NUMBER OF RECORDS OF SQUARES TO NUMBER OF SQUARES
LOOP ON NUMBER OF COUNTIES
(LOOP ENDS AT 9)
KK: POPULATION, HOUSING, AREA
(LOOP ENDS AT 9)
LOOP ON DIMENSIONS OF X AND Y
(LOOP ENDS AT 8)
8
INITIALIZE THE GRID SQUARE ARRAY TO ZERO
END OF LOOP
IS INPUT FOR POPULATION OR HOUSING
YES
INPUT DEVICE IS NOUT1
NO
IS INPUT FOR AREA
YES
INPUT DEVICE IS NOUT2
NO
p.2

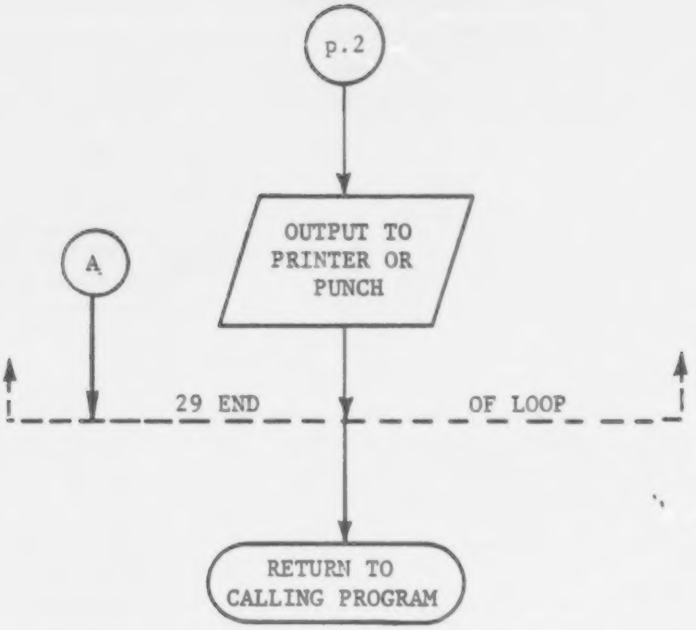
CAASE2
SUBROUTINE SQROFF
p.2

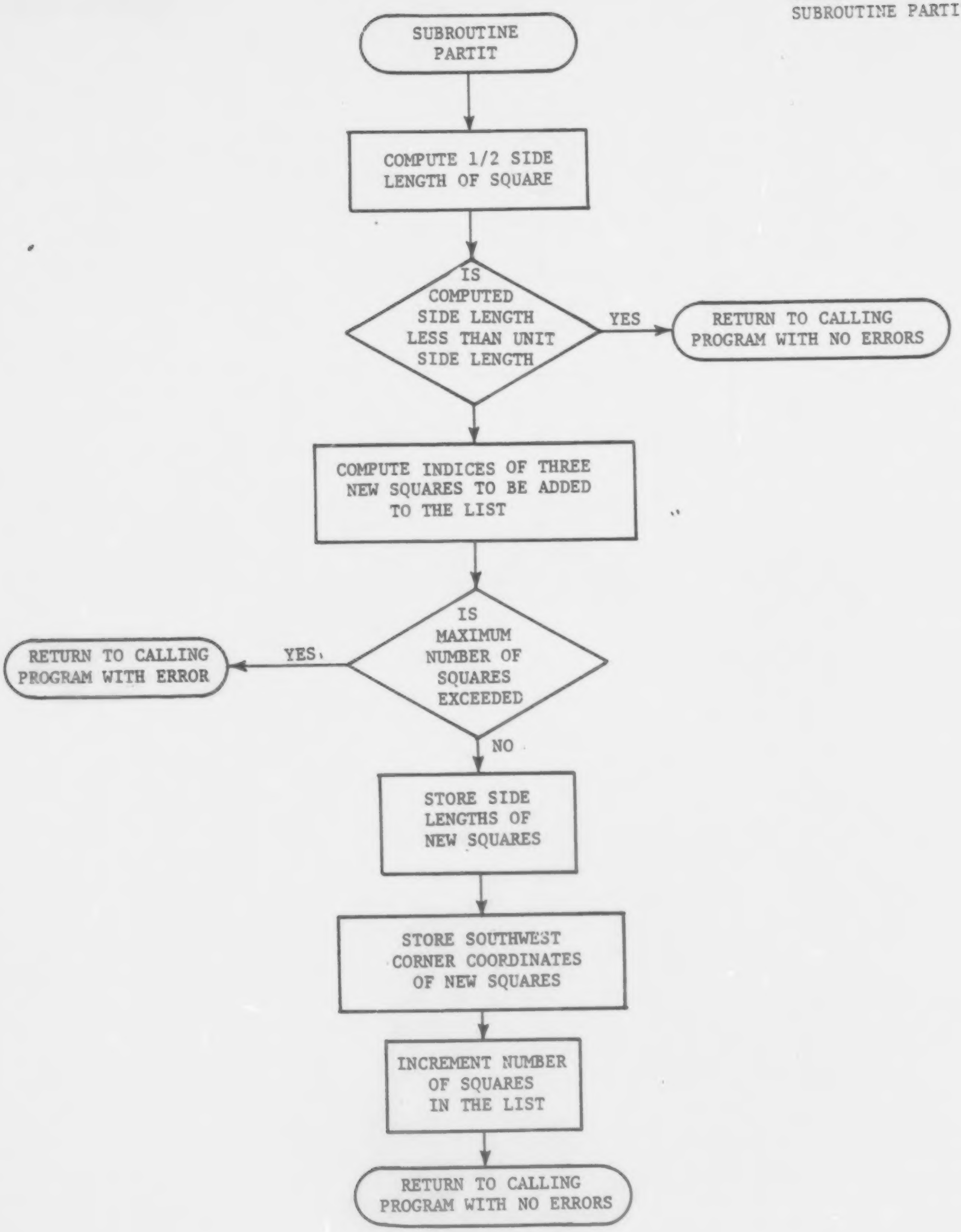

p.2
LOOP ON MIN. & MAX. INDICES FOR RECTANGLE CONTAINING THIS COUNTY
(LOOP ENDS AT 2)
2
READ DATA FROM THE INPUT DEVICE INTO THE GRID CELL ARRAY
END OF LOOP
WAS INPUT DEVICE FOR AREA
NO
YES
LOOP ON 2 DUPLICATE AREA ARRAYS
(LOOP ENDS AT 3)
3
SKIP PAST DUPLICATE AREA ARRAYS ON INPUT DEVICES
END OF LOOP
IS THIS THE FIRST PASS THROUGH THIS LIST
YES
INITIALIZE TOTAL NUMBER OF SQUARES TO TOTAL NUMBER DETERMINED IN SUBROUTINE GRIDIT
NO
LOOP ON NUMBER OF GRID SQUARES
(LOOP ENDS AT 9)
ASSUME INDEX OF GRID SQUARE RECORD EQUALS INDEX OF GRID SQUARE:
M = MPRIME
p.3

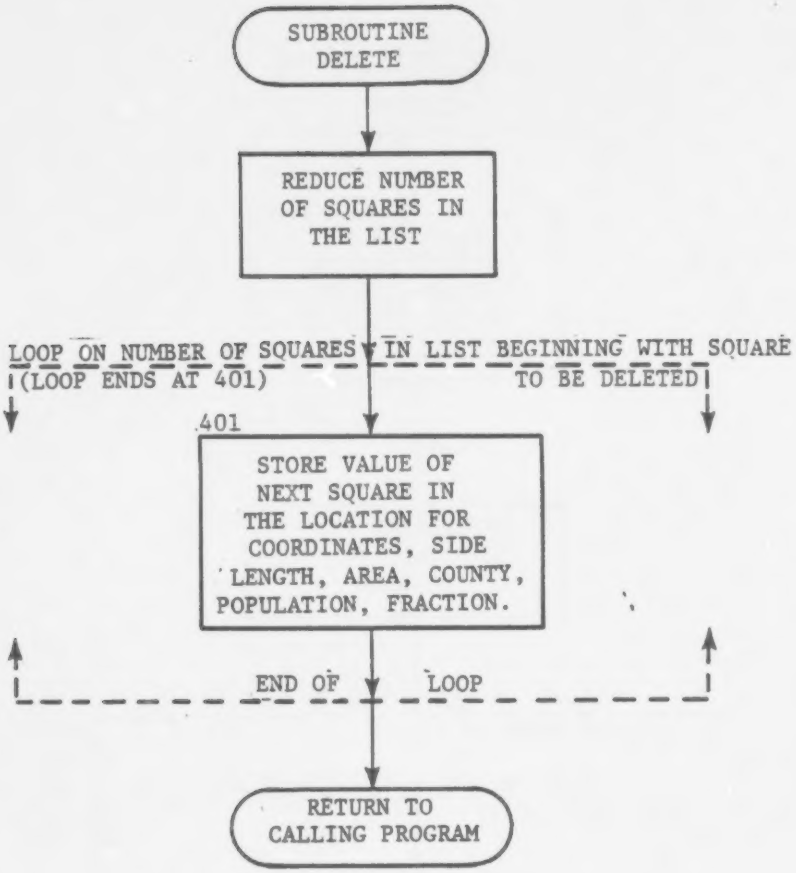

p.3
DOES SQUARE SHARE ANY COMMON AREA WITH RECTANGLE THAT CONTAINS THIS COUNTY
NO
A
YES
DOES SQUARE SHARE ANY COMMON AREA WITH COUNTY
NO
A
YES
CALL SUBROUTINE INTEGR TO TEST THE RESULT OF THAT INTEGRATION
IS THIS THE FIRST COUNTY TO HAVE CONTENTS IN THIS SQUARE
YES
NO
MAKE A DUPLICATE RECORD AND CHANGE THE INDEX OF THE SQUARE
INITIALIZE RECORD FOR A DUPLICATE SQUARE
6
ASSIGN THIS COUNTY TO CURRENT SQUARE
A
ACCORDING TO THE LOOP INDEX THE RESULT OF THE INTEGRATION IS POPULATION HOUSING OR AREA
9
END OF
LOOP
p.4

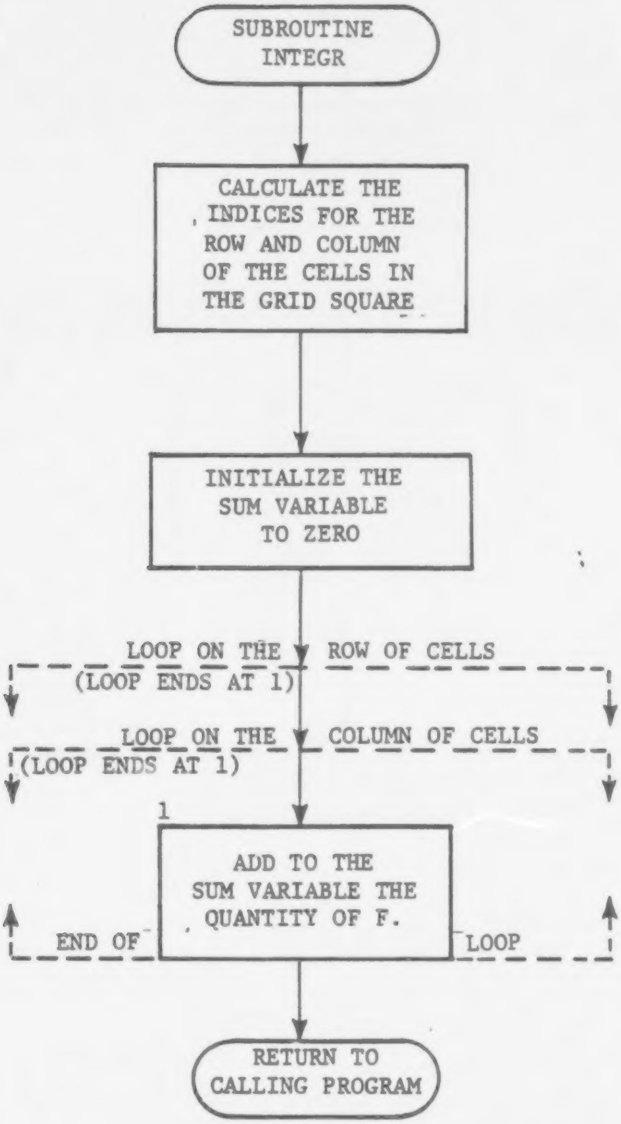

p.4
UPDATE THE NUMBER OF SQUARES IN THE LIST AS RESULT OF THE DUPLICATE SQUARES
RETURN TO CALLING PROGRAM

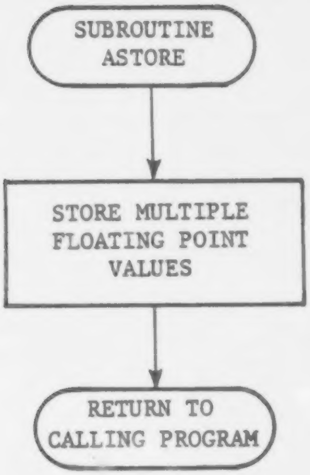

SUBROUTINE OUTPUT
PUNCH SUMMARY RECORD FOR THE STUDY AREA
LOOP ON 2
OUTPUT DEVICES
1 - PRINT
2 - PUNCH
(LOOP ENDS AT 29)
IS THIS FOR PRINTED OUTPUT
YES
SET OUTPUT DEVICE FOR PRINTER
NO
IS THIS FOR PUNCHED OUTPUT
YES
SET OUTPUT DEVICE FOR PUNCH
NO
INITIALIZE GRID SQUARE ID TO ZERO
LOOP ON NUMBER
OF GRID SQUARES
(LOOP ENDS AT 29)
IS THIS GRID UNPOPULATED
YES
A p.2
NO
CALCULATE COUNTY, STATE, FRACTION AND COORDINATES
p.2

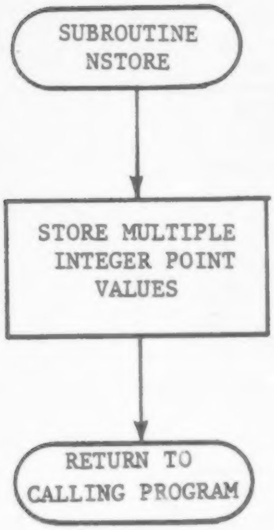

p.2
OUTPUT TO PRINTER OR PUNCH
A
29 END OF LOOP
RETURN TO CALLING PROGRAM

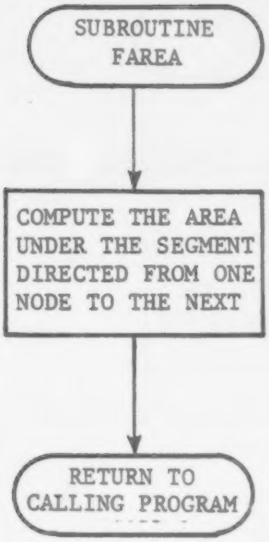

SUBROUTINE PARTIT
COMPUTE 1/2 SIDE LENGTH OF SQUARE
IS COMPUTED SIDE LENGTH LESS THAN UNIT SIDE LENGTH
YES
RETURN TO CALLING PROGRAM WITH NO ERRORS
COMPUTE INDICES OF THREE NEW SQUARES TO BE ADDED TO THE LIST
IS MAXIMUM NUMBER OF SQUARES EXCEEDED
YES
RETURN TO CALLING PROGRAM WITH ERROR
NO
STORE SIDE LENGTHS OF NEW SQUARES
STORE SOUTHWEST CORNER COORDINATES OF NEW SQUARES
INCREMENT NUMBER OF SQUARES IN THE LIST
RETURN TO CALLING PROGRAM WITH NO ERRORS

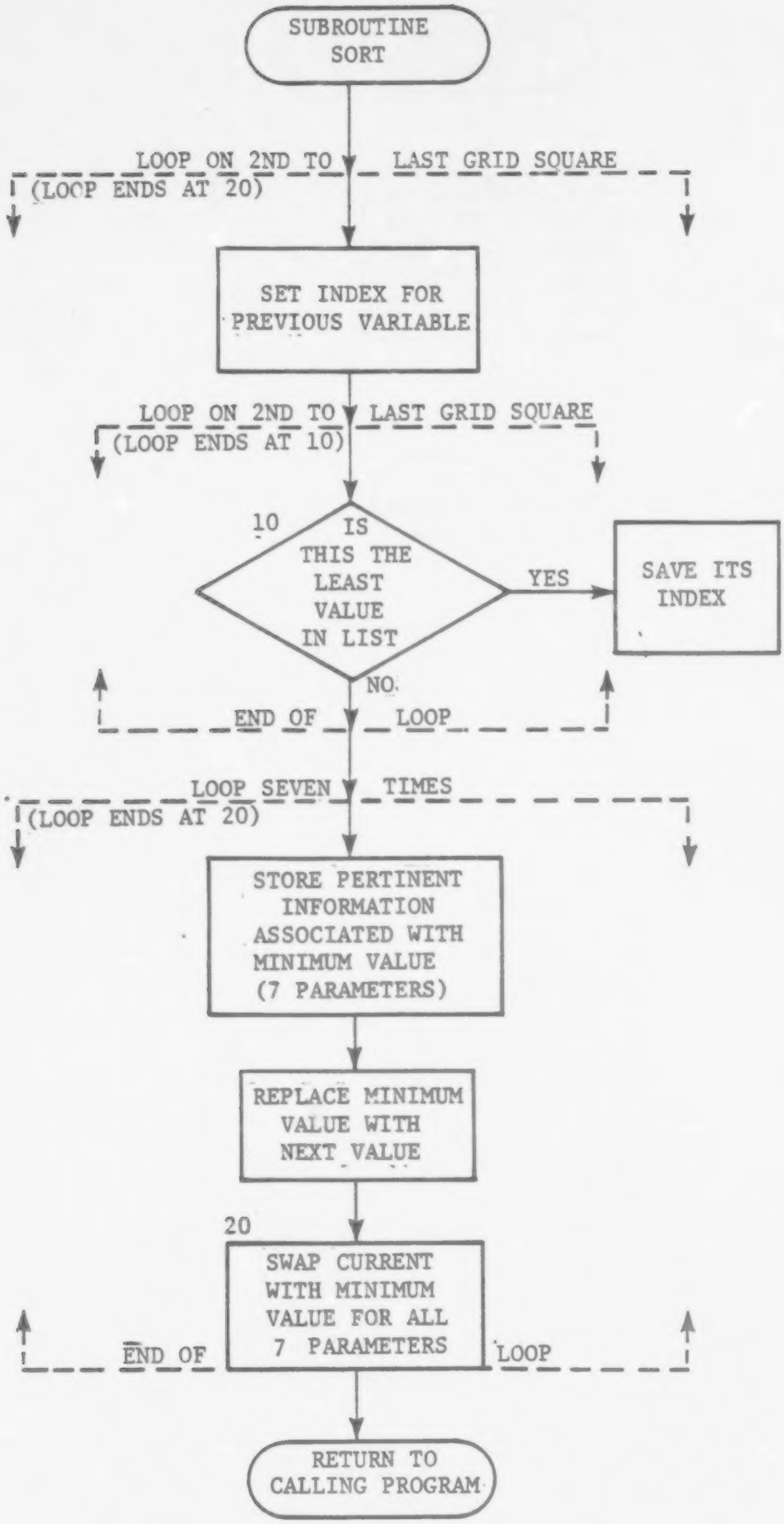

SUBROUTINE DELETE
REDUCE NUMBER OF SQUARES IN THE LIST
LOOP ON NUMBER OF SQUARES IN LIST BEGINNING WITH SQUARE TO BE DELETED
(LOOP ENDS AT 401)
401
STORE VALUE OF NEXT SQUARE IN THE LOCATION FOR COORDINATES, SIDE LENGTH, AREA, COUNTY, POPULATION, FRACTION.
END OF LOOP
RETURN TO CALLING PROGRAM


SUBROUTINE INTEGR
CALCULATE THE INDICES FOR THE ROW AND COLUMN OF THE CELLS IN THE GRID SQUARE
INITIALIZE THE SUM VARIABLE TO ZERO
LOOP ON THE ROW OF CELLS
(LOOP ENDS AT 1)
LOOP ON THE COLUMN OF CELLS
(LOOP ENDS AT 1)
1
ADD TO THE SUM VARIABLE THE QUANTITY OF F.
END OF
LOOP
RETURN TO CALLING PROGRAM


SUBROUTINE ASTORE
STORE MULTIPLE FLOATING POINT VALUES
RETURN TO CALLING PROGRAM


SUBROUTINE NSTORE
STORE MULTIPLE INTEGER POINT VALUES
RETURN TO CALLING PROGRAM


SUBROUTINE FAREA
COMPUTE THE AREA UNDER THE SEGMENT DIRECTED FROM ONE NODE TO THE NEXT
RETURN TO CALLING PROGRAM


SUBROUTINE SORT
LOOP ON 2ND TO LAST GRID SQUARE
(LOOP ENDS AT 20)
SET INDEX FOR PREVIOUS VARIABLE
LOOP ON 2ND TO LAST GRID SQUARE
(LOOP ENDS AT 10)
10
IS THIS THE LEAST VALUE IN LIST
YES
SAVE ITS INDEX
NO
END OF LOOP
LOOP SEVEN TIMES
(LOOP ENDS AT 20)
STORE PERTINENT INFORMATION ASSOCIATED WITH MINIMUM VALUE (7 PARAMETERS)
REPLACE MINIMUM VALUE WITH NEXT VALUE
20
SWAP CURRENT WITH MINIMUM VALUE FOR ALL 7 PARAMETERS
END OF LOOP
RETURN TO CALLING PROGRAM

```
C  INVOKE CAASE-2 PROCESSING ROUTINES AS SUBROUTINES.                  00000040
C                                                                      00000050
      INTEGER DIMENY,DIMENX                                            00000060
      DIMENSION F(256,256), LGO(256), KF(256,256), AREAIJ(256)         00000070
      EQUIVALENCE (F(1),KF(1)), (LGO(1),AREAIJ(1))                     00000080
C                                                                      00000090
      COMMON /VECFOR/ AQCR(5), STATE(5,10), CNTY(5,15), IDCO(15),      00000100
     1      NRECO(15),IY(2520),JX(2520),POP(2520),HOUS(2520),AREA(2520) 00000110
C                                                                      00000120
      COMMON /LINFO/ NSTATE, NUMCO, NRECT, NX, NY, LTWO, GXMIN, GXMAX, 00000130
     1 GYMIN, GYMAX, XORIG, YORIG, MTZU, ID, YASSOC                    00000140
C                                                                      00000150
C**** FILE DEVICE NUMBERS                                              00000160
C       NR     READER                                                  00000170
C       NP     PRINTER                                                 00000180
C       NPUNCH PUNCH                                                   00000190
C       NIN1   COUNTY OUTLINES                                         00000200
C       NIN2   CENSUS DATA FROM CAASE 1.                               00000210
C       NOUT1  SCRATCH OUTPUT TAPE THAT WILL CONTAIN POPULATION AND    00000220
C              HOUSING.                                                00000230
      COMMON /IOFILE/ NR, NP, NPUNCH, NIN1, NIN2, NOUT1, NOUT2         00000240
C*****  MISCELLANEOUS PARAMETERS                                       00000250
      COMMON /IPARM/ UNITAR, ISHIFT, XMAXD, YMAXD, EPS, MAXSQR         00000260
      NR = 1                                                           00000270
      NP = 3                                                           00000280
      NPUNCH = 2                                                       00000290
      NIN1 = 6                                                         00000300
      NIN2 = 7                                                         00000310
C                                                                      00000320
      NOUT1 = 8                                                        00000330
      NOUT2 = 9                                                        00000340
C                                                                      00000350
      DIMENY = 256                                                     00000360
      DIMENX = 256                                                     00000370
C                                                                      00000380
      LTWO = 32                                                        00000390
      UNITAR = 1.                                                      00000400
      ISHIFT = 2**16
      XMAXD = DIMENX
      YMAXD = DIMENY
      EPS = .0001
      MAXSQR = 1800
C
      MAXTRY = 3
      NTRYS = 0
C
C  READ COUNTY OUTLINES FROM DEVICE NIN1.  CONVERT TO UTM PRIMARY ZONE
C  AND WRITE THE RESULTS ON NOUT1.
C
      CALL INBOUN
      REWIND NIN1
      REWIND NOUT1
C
C  PROCESS L=1,2,...,NUMCO COUNTIES.
C
      DO 31 L=1,NUMCO
      ISTATE = IDCO(L)/1000
      ICOUNT = IDCO(L)-ISTATE*1000
      WRITE(NP,102) L, ISTATE, ICOUNT, (CNTY(N,L),N=1,5)
  102 FORMAT(5X' STATECODE / COUNTY CODE / COUNTY NAME'I5,2I10,5A4)
  103 FORMAT(//' NUMBER OF CENSUS CONTROL CELLS =',I6,' EXCEEDS 2520 DIM
     1ENSIONAL STORAGE.  CAASE2 TERMINATED AFTER * *CALL INPUP* *')
C
C  READ IN COORDINATES OF COUNTY OUTLINE SEGMENTS
C
C  TRACK THE BOUNDARY OF EACH COUNTY THROUGH THE UNIT CELL GRID MATRIX
C  DETERMINE WHICH UNIT CELLS ARE INTERIOR TO, EXTERIOR TO, AND ON THE
C  COUNTY OUTLINE BOUNDARY WITHIN THE CONTAINING RECTANGLE WHICH GOES
C  FROM IGO TO IKWIT, JGO TO JKWIT.)
C
      CALL TRACKR(F,DIMENY,DIMENX,NUMSEG,-UNITAR,IGO,IKWIT,JGO,JKWIT,L)
C
C  AFTER TRACKER, ARRAY F(I,J) CONTAINS VALUES OF AREA:
C           = 0           IF UNIT CELL IS OUTSIDE THE BOUNDARY.
```

```
C         .LE.UNITAR     IF UNIT CELL IS ON THE BOUNDARY.
C          = UNITAR      IF UNIT CELL IS COMPLETELY INTERIOR TO BOUNDARY
C
C  PRINT THE PROXIMAL MAP OF THE COUNTY ON THE PRINTER
C
      CALL PROXPR  (F,DIMENY,DIMENX,IGO,IKWIT,JGO,JKWIT,0.,0.5,UNITAR)
      WRITE(NOUT2) L, IDCO(L),IGO,IKWIT,JGO,JKWIT
      DO 31 KK=1,5
      DO 31 I=IGO,IKWIT
   31 WRITE(NOUT2) (F(I,J),J=JGO,JKWIT)
      REWIND NOUT2
      REWIND NOUT1
C
      DO 54 L=1,NUMCO
C
C  READ THE CENSUS POPULATION DATA EXTRACTED BY CAASE 1 INTO THE INTEGER
C  ARRAY KF(Y,X).  INPOP WILL SORT THE NON-ZERO VALUES OF KF(Y,X) BY
C  ASCENDING COLUMNS BY ROWS AND PLACE IN VECTOR STORAGE.
C
      ISTATE = IDCO(L)/1000
      ICOUNT = IDCO(L) - ISTATE*1000
      WRITE(NP,102) LL, ID, IGO, IKWIT, JGO, JKWIT
      READ(NOUT2) LL, ID, IGO, IKWIT, JGO, JKWIT
C
      CALL INPOP(KF,DIMENY,DIMENX,IGO,IKWIT,JGO,JKWIT,TOTPOP,TOTHOS,
     1 NMCNTL, ISTATE, ICOUNT)
C
      IF(NMCNTL.LT.2520) GO TO 5
      WRITE(NP,103) NMCNTL
      STOP
C
C  AFTER 'INPOP' ARRAY F(Y,X) CONTAINS VALUES OF POPULATION.
C  = POPULATION(Y,X)*2**16 + HOUSING(Y,X) IF THE UNIT CELL CENTERED ON
C  (Y+UNITAR/2, X+UNITAR/2) CONTAINS ANY CENSUS ENUMERATION DISTRICT
C  CENTROIDS.
C  = 0 OTHERWISE.
C
```

Reproduced from
best available copy.

```
C  CREATE THE PROXIMAL MAP FOR THIS COUNTY
C
   5 CONTINUE
     KK=1
     DO 32 I=IGO,IKWIT
  32 READ(NOUT2) (F(I,J),J=JGO,JKWIT)
C
     CALL PROXML(F,DIMENY,DIMENX,IGO,IKWIT,JGO,JKWIT,LGO,NMCNTL)
C
C  PROXML RETURNS F(Y,X) SO THAT FOR A GIVEN (Y,X), F= THE INDEX OF THE
C  NEAREST CONTROL CELL.
C
C  WRITE ARRAYS OF CONTAINED POPULATION AND HOUSING ON DEVICE NOUT1.
C
     WRITE(NOUT1) L, IDCO(L), IGO, IKWIT, JGO, JKWIT
     DO 34 KK=2,3
     DO 34 I=IGO,IKWIT
     READ( NOUT2) (AREAIJ(J),J=JGO,JKWIT)
     DO 33 J=JGO,JKWIT
     LL = F(I,J)
     IF(LL.EQ.0)GO TO 33
     IF(KK.EQ.2) AREAIJ(J) = POP(LL)*AREAIJ(J)
     IF(KK.EQ.3) AREAIJ(J) = HOUS(LL)*AREAIJ(J)
  33 CONTINUE
  34 WRITE(NOUT1) (AREAIJ(J),J=JGO,JKWIT)
C
 200 REWIND NOUT1
C  PARTITION THE MATRIX OF UNIT AREA GRID CELLS INTO SQUARES:
C
C    INITIALIZE GRID CELL ARRAY
     DO 35 J=1,DIMENX
     DO 35 I=1,DIMENY
  35 F(I,J)=0.
C
C    READ THE PROXIMAL MAPS FOR ALL COUNTIES INTO THE GRID CELL ARRAY.
     DO 7 L=1,NUMCO
     READ(NOUT1) LL, IOL, IGO, IKWIT, JGO, JKWIT
```

```
      DO 6 I=IGO,IKWIT                                                  00001520
      READ(NOUT1) (AREAIJ(J),J=JGO,JKWIT)                               00001530
      DO 6 J=JGO,JKWIT                                                  00001540
    6 F(I,J) = F(I,J) + AREAIJ(J)                                       00001550
      DO 7 I=IGO,IKWIT                                                  00001560
    7 READ(NOUT1) DUMM                                                  00001570
C                                                                       00001580
C  GRID CELL ARRAY F(I,J) NOW CONTAINS VALUES OF POPULATION OVER ALL    00001590
C  COUNTIES.                                                            00001600
C                                                                       00001610
C  RETURN #10 IF THE NUMBER OF GRID SQUARES EXCEEDS THE MAX PERMISSIBLE.00001680
C                                                                       00001690
   36 CALL GRIDIT(&10,F,DIMENY,DIMENX,FMAX,ICOUNT,TOTPOP,TOTHOS,NUMSQR) 00001700
C                                                                       00001710
C  DELETE EMPTY SQUARES AND ADJUST BOUNDARY SQUARES.                    00001720
C                                                                       00001730
      CALL ADJUST(&10,NUMSQR)                                           00001740
C                                                                       00001750
C  INTEGRATE POPULATION, HOUSING AND AREA BY COUNTY BY GRID SQUARE:     00001760
C                                                                       00001770
   37 REWIND NOUT1                                                      00001780
      REWIND NOUT2                                                      00001790
C                                                                       00001800
      CALL SQROFF(&10,NUMSQR)                                           00001810
C                                                                       00001820
C  SORT THE SQUARES BY STATE BY COUNTY BY NORTHING BY EASTING:          00001830
      CALL SORT(NUMSQR)                                                 00001840
C                                                                       00001850
C  WRITE THE GRID SQUARE RECORDS                                        00001860
C                                                                       00001870
      CALL OUTPUT                                                       00001880
C                                                                       00001890
      WRITE(NP,105)                                                     00001920
  105 FORMAT( //'  FINISH CAASE2')                                      00001930
      STOP                                                              00001940
C                                                                       00001950
C  #10 IN CASE NUMSQR EXCEEDS MAXSQR, INCREASE PARTITIONING THRESHOLD   00001960
```

```
C  FMAX AND TRY AGAIN.
C
   10 TMAX = FMAX*1.5
      IF(NTRYS.LT.MAXTRY)WRITE(NP,106) NUMSQR,MAXSQR,TMAX,FMAX
  106 FORMAT(//' THE NUMBER OF GRID SQUARES,',I6,', NOW EXCEEDS THE MAXI
     1MUM PERMISSIBLE,',I6,'.'/' WILL PARTITION AGAIN WITH NEW FMAX,',
     2 E12.5,', EQUAL 1.5*PREVIOUS FMAX,',E12.5)
      NTRYS = NTRYS + 1
      IF(NTRYS.LE.MAXTRY)GO TO 200
      STOP
      END
      SUBROUTINE INBOUN                                                 00000050
C                                                                       00000030
C  READ IN THE COUNTY OUTLINES.                                         00000040
C                                                                       00000010
      REAL*8 DFE,DFN,DTE,DTN                                            00000060
C  NOUT3  - THE SUBSET OF THE TOTAL COUNTY OUTLINE FILE COMPRISING THIS 00000190
C             STUDY AREA IN DIME FORMAT.  (OPTIONAL)                    00000200
C  NPLOT  - THE SUBSET OF THE TOTAL COUNTY OUTLINE FILE FOR CAASE3      00000204
C           (DUPLICATE OF NOUT1) (OPTIONAL)                             00000205
C                                                                       00000210
C                                                                       00000220
C*****READ CONTROL CARDS                                                00000230
      COMMON /VECFO/ AQCR(5), STATE(5,10), CNTY(5,15), IOCO(15),        00000070
     1          NRECO(15),SMX(4,3150)                                   00000080
      COMMON /LINFO/ NSTATE, NUMCO, NRECT, NX, NY, LTWO, GXMIN,         00000090
     1          GXMAX, GYMIN, GYMAX, XORIG, YORIG, MTUZ, ID, YASSOC     00000100
      COMMON /IOFILE/ NR, NP, NPUNCH, NIN1, NIN2, NOUT1, NOUT2          00000110
C  NR      - CARD READER                                                00000120
C  NP      - PRINTER                                                    00000130
C  NPUNCH  - CARD PUNCH                                                 00000140
C  NIN1    - COUNTY OUTLINES; INPUT DATA                                00000150
C  NIN2    - CAASE1 CENSUS DATA FILE; INPUT DATA                        00000160
C  NOUT1   - COUNTY OUTLINE NODES; OUTPUT FILE                          00000170
C  NOUT2   - SCRATCH OUTPUT FILE                                        00000180
      READ(NR,101) NSTATE, AQCR, MTUZ, NOUT3, NPLOT                     00000240
      IF (NPLOT.GT.0) WRITE(NPLOT,101)NSTATE, AQCR, MTUZ, NOUT3, NPLOT  00000250
  101 FORMAT(I4,5A4,I4,2I4)                                             00000260
      WRITE(NP,102) AQCR, NSTATE, MTUZ                                  00000270
  102 FORMAT('1AIR QUALITY CONTROL REGION IS ',5A4,//,6X,               00000280
     1        'NO. OF STATE(S) INCLUDED IS ',I4,10X,                    00000290
     2        'PRIMARY UTM ZONE IS ',I4,///)                            00000300
      NUMCO=0                                                           00000310
C                                                                       00000320
C     *READ  IN STATE BY STATE                                          00000330
C  THE COUNTY OUTLINES WANTED, A SUBSET OF THE TOTAL COUNTY OUTLINE FILE00000340
C  , CAN BE SAVED TO OBVIATE READING FROM THE TOTAL FILE IN THE FUTURE  00000350
C  BY SPECIFYING OUTPUT DEVICE NOUT3 NON-ZERO.  'INBOUN' WILL WRITE THE 00000360
```

Reproduced from
best available copy.

```
C   COUNTY OUTLINES TO NON-ZERO NOUTS.                                  00000370
C                                                                       00000380
      DO 10 K=1,NSTATE                                                  00000390
      READ(NR,101) NCNTY,(STATE(L,K),L=1,5),ICODE                       00000400
      WRITE(NPUNCH,101) NCNTY,(STATE(L,K),L=1,5),ICODE                  00000410
      NSTART=NUMCO+1                                                    00000420
      NEND=NUMCO+NCNTY                                                  00000430
  103 FORMAT(I4,5A4)                                                    00000440
      WRITE(NP,104) (STATE(L,K),L=1,5),NCNTY, ICODE                     00000450
  104 FORMAT('0',5X,'THE STATE OF ',5A4,' HAS',I4,                      00000460
     1       ' COUNTIES IN THE STUDY AREA',2I4)                         00000470
      DO 20 I=NSTART,NEND                                               00000480
           READ(NR,103) IDCO(I),(CNTY(M,I),M=1,5)                       00000490
            IF(NPLOT.GT.0) WRITE(NPLOT,103) IDCO(I),(CNTY(M,I),M=1,5)   00000500
           IDCO(I)=IDCO(I) + 1000*ICODE                                 00000510
           WRITE(NP,105) (CNTY(M,I),M=1,5),IDCO(I)                      00000520
  105      FORMAT('0','COUNTY ',5A4,'  HAS STATE-CNTY CODE(FIPS) ',I7)  00000530
           IF(I.EQ.1) GO TO 20                                          00000540
           IF(IDCO(I).GT.IDCO(I-1) ) GO TO 20                           00000550
C         *ERROR EXIT                                                   00000560
           WRITE(NP,106)                                                00000570
  106      FORMAT(' *****ERROR***** STATE-CNTY CODES NOT IN ASCENDING', 00000580
     1             ' NUMERICAL ORDER')                                  00000590
           STOP 21                                                      00000600
   20      CONTINUE                                                     00000610
      NUMCO=NUMCO+NCNTY                                                 00000620
   10 CONTINUE                                                          00000630
C                                                                       00000640
C*****INITIALIZE SUMMARY VARIABLES  ( ALL COUNTIES )                    00000650
 1040 GXMIN=9.99E+23                         .                          00000660
      GYMIN=9.99E+23                                                    00000670
      GXMAX=-9.99E+23                                                   00000680
      GYMAX=-9.99E+23                                                   00000690
      NRECT=0                                                           00000700
      INXCO=0                                                           00000710
      ICPREV=0                                                          00000720
C                                                                       00000730
```

```
C*****SEARCH FOR STARTING RECORD
 1030 READ(NIN1,701,END=4000 ) ID,IFE,IFN,ITE,ITN,MZONE
      FE = IFE/10.
      FN = IFN/10.
      TE = ITE/10.
      TN = ITN/10.
  701 FORMAT(I5,12X,2I5,2X,2I5,I2)
      IF(ID.LT.IDCO(1) ) GO TO 1030
      IF(ID.EQ.IDCO(1)) GO TO 1000
C     *ERROR EXIT
      WRITE(LP,211) IDCO(1)
      STOP 25
C
C*****MAIN LOOP
C     *CONVERT UTM ZONE IF NECESSARY
 1000 CONTINUE
C   WRITE TO DEVICE NOUTS IF .GT. 0 TO OBVIATE FUTURE TAPE READ-IN:
      IF(NOUTS.GT.0)WRITE(NOUTS,701)ID,IFE,IFN,ITE,ITN,MZONE
C
C     *IF NEW COUNTY PROCESS HEADER REC  ,OTHERWISE REGULAR REC
      IF(ID.EQ.IDPREV) GO TO 2000
C
C   ***PROCESS COUNTY HEADER RECORD
C     *IF FIRST COUNTY,SKIP PROCESSING OF PREVIOUS COUNTY
      IF(IDPREV.EQ.0) GO TO 1010
C           *OUTPUT PREVIOUS COUNTY'S INFO
             NRECO(INXCO) =NUMSEG
             ISTART=NRECT+1
             NRECT=NRECT + NUMSEG
             IEND=NRECT
             IF(LPROB.NE.0) WRITE(LP,307) IDPREV
  307        FORMAT(' OUTLINE SEGMENTS NOT CHAINED FOR CNTY=',I10)
             IF(LPROB.GT.0) STOP 51
C     *THE FOLLOWING SIX CARDS SHOULD REALLY BE INDENTED, BUT ARE'NT
      IF(XL.LT.GXMIN) GXMIN=XL
      IF(YL.LT.GYMIN) GYMIN=YL
      IF(XH.GT.GXMAX) GXMAX=XH
      IF(YH.GT.GYMAX) GYMAX=YH                                          00001110
      WRITE(NOUT1,801) IDPREV,XL,YL,XH,YH                               00001120
      WRITE(NP,801) IDPREV,XL,YL,XH,YH                                  00001130
      IF (NPLOT.GT.0) WRITE(NPLOT,801)IDPREV,XL,YL,XH,YH                00001140
  801       FORMAT(I10,4F10.1)                                          00001150
            WRITE(NOUT1,802) ((SMX(J,I),J=1,4),I=ISTART,IEND)           00001160
            WRITE(NP,802    ) ((SMX(J,I),J=1,4),I=ISTART,IEND)          00001170
            IF (NPLOT.GT.0) WRITE(NPLOT,802)((SMX(J,I),J=1,4,I=ISTART,  00001180
     *      IEND)                                                       00001181
  802       FORMAT(10X,4F10.1)                                          00001190
C     *INITIALIZE FOR NEW COUNTY                                        00001200
 1010 IDPREV=ID                                                         00001210
      NUMSEG=0                                                          00001220
      INXCO=INXCO+1                                                     00001230
      LPROB=0                                                           00001240
      PTE=-9.99E+23                                                     00001250
      PTN=-9.99E+23                                                     00001260
      XL=9.99E+23                                                       00001270
      YL=9.99E+23                                                       00001280
      XH=-9.99E+23                                                      00001290
      YH=-9.99E+23                                                      00001300
      GO TO 3000                                                        00001310
C                                                                       00001320
C   ***PROCESS REGULAR OUTLINE RECORDS                                  00001330
 2000 NUMSEG=NUMSEG+1                                                   00001340
      ISMX=NRECT+NUMSEG                                                 00001350
      NTOFIX=NTOZ-NZONE                                                 00001360
      IF(IABS(NTOFIX).LE.1) GO TO 1014                                  00001370
C           *ERROR EXIT                                                 00001380
             WRITE(NP,305) ID,NZONE                                     00001390
  305       FORMAT(' ERROR:STATE-CNTY=',I10,'HAS BAD ZONE =',I10)       00001400
             STOP 25                                                    00001410
 1014 IF(NTOFIX.EQ.0) GO TO 1011                                        00001420
      LERR=0                                                            00001430
      XOR=NTOFIX                                                        00001440
      IF(XOR.EQ.-1.) XOR=.0                                             00001450
      DFE=DBLE(FE)                                                      00001460
      DFN=DBLE(FN)
      DTE=DBLE(TE)
      DTN=DBLE(TN)
      CALL GIGR(DFN,DFE,XOR,LERR)
      CALL GIGR(DTN,DTE,XOR,LERR)
      FE=SNGL(DFE)
      FN=SNGL(DFN)
      TE=SNGL(DTE)
      TN=SNGL(DTN)
      IF(LERR.EQ.0) GO TO 1011
C           *ERROR EXIT
             WRITE(OP,306) ID
  306        FORMAT(' UTM CONVERSION BAD FOR STATE-CNTY=',I10)
             STOP 20
 1011 CONTINUE
      IF(FE.LT.XL) XL=FE
      IF(FE.GT.XH) XH=FE
      IF(FN.LT.YL) YL=FN
      IF(FN.GT.YH) YH=FN
      IF(TE.EQ.XL.AND.TE.LT.GXMIN) ILEFT=ISMX
 1012 SMX(1,ISMX)=FE
      SMX(2,ISMX)=FN
      SMX(3,ISMX)=TE
      SMX(4,ISMX)=TN
C    *CHECK FOR HEAD TO TAIL MATCH
      IF(FE.NE.PTE.AND.PTE.NE.-9.99E+23) LPROB=1
      IF(FN.NE.PTN.AND.PTN.NE.-9.99E+23) LPROB=1
C    *RESET PREVIOUS VALUES
      IDPREV=ID
      PTE=TE
      PTN=TN
C
C   ***READ A NEW RECORD
 5000 READ(NIN1,701,END=4000) ID,IFE,IFN,ITE,ITN,NZONE
      FE = IFE/10.
      FN = IFN/10.
      TE = ITE/10.
      TN = ITN/10.
      IF(FF.EQ.TE.AND.FN.EQ.TN) GO TO 3000
      IF(INXCO.EQ.NUMCO.AND.ID.NE.IDPREV) GO TO 4000
      IF(ID.EQ.IDPREV.OR.ID.EQ.IDCO(INXCO+1)) GO TO 1000
      IF(ID.LT.IDCO(INXCO+1)) GO TO 3000
C     *ERROR EXIT
      WRITE(NP,211) IDCO(INXCO+1)
  211 FORMAT(' ERROR: STATE-CNTY CODE',I7,' NOT FOUND IN OUTLINE FILE')
      STOP 28
C
C*****END OF FILE ACTION OR END OF REQUESTED COUNTIES ACTION
 4000 CONTINUE
C            *OUTPUT PREVIOUS COUNTY'S INFO
             NRECO(INXCO) =NUMSEG
             ISTART=NRECT+1
             NRECT=NRECT + NUMSEG
             IEND=NRECT
                     IF(XL.LT.GXMIN) GXMIN=XL
                     IF(YL.LT.GYMIN) GYMIN=YL
                     IF(XH.GT.GXMAX) GXMAX=XH
                     IF(YH.GT.GYMAX) GYMAX=YH
            IF(LPROB.NE.0) WRITE(NP,307) IDPREV
            IF(LPROB.NE.0) STOP 31
            WRITE(NOUT1,801) IDPREV,XL,YL,XH,YH
            WRITE(NP,801) IDPREV,XL,YL,XH,YH
        IF  (NPLOT.GT.0) WRITE(NPLOT,802)IDPREV,XL,YL,XH,YH
             WRITE(NOUT1,802) ((SMX(J,I),J=1,4),I=ISTART,IEND)
             WRITE(NP,802    ) ((SMX(J,I),J=1,4),I=ISTART,IEND)
        IF  (NPLOT.GT.0) WRITE(NPLOT,802)((SMX(J,I),J=1,4),I=ISTART,IEND)
C     *ERROR EXIT
      IF(ID.LT.IDCO(INXCO) ) WRITE(NP,211)
      IF(ID.LT.IDCO(INXCO) ) STOP 29
C
C   ***CALCULATE # LTHD BLOCKS ETC
      XSPAN=GXMAX-GXMIN
      YSPAN=GYMAX-GYMIN
      NX=IFIX(XSPAN/FLOAT(LTHD) )+1
      NY=IFIX(YSPAN/FLOAT(LTWO) )+1                                     00002210
      EXTRAX=(NX*LTWO-XSPAN)/2.0                                        00002220
      EXTRAY=(NY*LTWO-YSPAN)/2.0                                        00002230
      NXORIG=GXMIN-EXTRAX                                               00002240
      NYORIG=GYMIN-EXTRAY                                               00002250
      XORIG=NXORIG                                                      00002260
      YORIG=NYORIG                                                      00002270
C                                                                       00002280
      RETURN                                                            00002290
      END                                                               00002300
      SUBROUTINE TRACKR(AREA,DIMENY,DIMENX,NUMSEG,UNITAR,IGO,IKWIT,JGO,
     1 JKWIT,LM)
C  RTI.C41.P01403.TRACKER.FORT
C
C  TRACK THE BOUNDARY OF THE LM-TH. COUNTY THROUGH THE GRID CELLS IN
C  ARRAY AREA(I,J).
C  COMPUTE THE CONTAINED AREA OF THE BOUNDARY CELLS.
C  DETERMINE THE INTERIOR CELLS.
C  BASIC ASSUMPTION IS THAT TRAVEL IS DIRECTED COUNTER CLOCKWISE.
C  COMPUTE THE TOTAL ENCLOSED AREA.  IF IT IS NOT NEGATIVE, DIRECTION IS
C  CLOCKWISE AND NODES MUST BE REORDERED.
C
C  NODE COORDINATES (X1,Y1), (X2,Y2) ARE ADJUSTED TO ORIGIN BY
C  CALLING PROGRAM.
C
C  UNIT AREA, "UNITAR", IS PASSED AS A NEGATIVE UNITAR.
C  LM IS COUNTY INDEX.
C
      INTEGER DIMENX,DIMENY
      LOGICAL SIDE(4), FIRSTM
      DIMENSION AREA(DIMENY,DIMENX)
      COMMON /VECFO/ AQCR(5), STATE(5,10), CNTY(5,15), IDCO(15),
     1               NRECO(15), X1(3150),X2(3150),Y1(3150),Y2(3150)
C
      COMMON /LINFO/ NSTATE, NUMCO, NRECT, NX, NY, LTWO, GXMIN, GXMAX,
     1               GYMIN, GYMAX, XORIG, YORIG, MTUZ, ID, YASSOC
      COMMON /IOFILE/ NR, NP, NPUNCH, NIN1, NIN2, NOUT1, NOUT2
      COMMON /IPARM/DUMM,ISHIFT,XMAXD,YMAXD, EPS, MAXSQR
C      WRITE(NP,101) LM, XORIG, YORIG
C
C  READ IN THE COUNTY OUTLINE COORDINATES.
C
      READ(NOUT1,101)LD,XMIN,YMIN,XMAX,YMAX
      XMIN = XMIN-XORIG
      XMAX = XMAX-XORIG
      YMIN = YMIN - YORIG
      YMAX = YMAX - YORIG
```

```
C      WRITE(NP,101)LD,XMIN,YMIN,XMAX,YMAX
      NUMSEG = NRECO(LM)
      DO 5 M=1,NUMSEG
      READ(NOUT1,102)X1(M),Y1(M),X2(M),Y2(M)
      X1(M) = X1(M) - XORIG
      Y1(M) = Y1(M) - YORIG
      X2(M) = X2(M) - XORIG
      Y2(M) = Y2(M) - YORIG
C    5 WRITE(NP,101)M, X1(M),Y1(M),X2(M),Y2(M)
    5 CONTINUE
      IGO = YMIN - 1
      IF(IGO.LE.0)IGO=1
      IKWIT = YMAX + 1
      IF(IKWIT.GT.DIMENY)IKWIT=DIMENY
      JGO = XMIN - 1
      IF(JGO.LE.0)JGO=1
      JKWIT = XMAX + 1
      IF(JKWIT.GT.DIMENX)JKWIT=DIMENX
      DO 6 J=JGO,JKWIT
      DO 6 I=IGO,IKWIT
    6 AREA(I,J) = 0.
  101 FORMAT(I10,4F10.1)
  102 FORMAT(10X4F10.1)
C
C  TEST DIRECTIONALITY:
C
      TAREA = 0.
      DO 1 L=1,NUMSEG
      T=FAREA(X1(L),Y1(L),X2(L),Y2(L))
    1 TAREA = TAREA + T
      WRITE(NP,1023)(CNTY(MM,LM),MM=1,5), TAREA
 1023 FORMAT(/' TRACKER COMPUTES TOTAL AREA OF ',5A4,'COUNTY AS :',E12.4
     1)
C
C  IF SIGN OF AREA IS NOT NEGATIVE,  I.E. IF DIRECTION IS NOT COUNTER-
C  CLOCKWISE, REORDER THE SEGMENTS AND NODES:
C
```

```
      IF(TAREA.LT.0.)GO TO 10
      CALL REORDR(NUMSEG,X1,Y1,X2,Y2)
      TAREA=0.
      DO 111 L=1,NUMSEG
       T=FAREA(X1(L),Y1(L),X2(L),Y2(L))
  111 TAREA = TAREA + T
      WRITE(NP,1023) (CNTY(MM,LM),MM=1,5),TAREA
C
   10 XENTER = 2.*XMAXD
      YENTER = 2.*YMAXD
C  INITIALIZE COUNTERS
C
      ISIDE=0
      IEXIT=0
      IENTER=0
      FIRSTM=.TRUE.
C
C  'L' COUNTS SEGMENTS
      L=0
    2 L=L+1
      IF(L.GT.NUMSEG) GO TO 9
      XX=X1(L)
      YY=Y1(L)
      J1 = X1(L) + 1.0
      I1 = Y1(L) + 1.0
      DELX = X2(L)-X1(L)
      DELY = Y2(L)-Y1(L)
C       PRINT 1000,L,I1,J1,DELX,DELY
 1000 FORMAT(/' 2 L I1 J1 DELX DELY'/3I3,2F10.4)
    3 XM=J1-1
      XP=J1
      YM=I1-1
      YP=I1
C       PRINT 1001,L, J1, XM, XP, I1, YM, YP
 1001 FORMAT(/' 3 L',I5,2(I5,2F10.2))
C
C  TEST SEGMENT FROM (XX,YY) TO (X2(L),Y2(L)) FOR INTERSECTION (X,Y)
```

```
C  WITH SIDES OF CELL (I1,J1).
C  IF THE TERMINUS OF THE SEGMENT IS INSIDE THE CELL, (X,Y) WILL BE
C  RETURNED EQUAL TO (X2(L),Y2(L)).
C
    4 CALL SIDEIT(XM,XP,YM,YP,XX,YY,X2(L),Y2(L),X,Y,ISIDE,NUM,SIDE)
C
C  COMPUTE THE AREA IN CELL (I1,J1) CONTAINED BY THE SEGMENT FROM
C  (XX,YY) TO (X,Y)
    8 AREA(I1,J1)=AREA(I1,J1)+FAREA(XX,YY,X,Y)
C        PRINT1010,L,I1,J1,IENTER,XENTER,YENTER,IEXIT,XX,YY,X,Y,AREA(I1,J1
 1010 FORMAT( ' L   I1   J1 IENTER XENTER YENTER IEXIT XX YY X Y'/
     1 4I4,2F6.2,I4,5F6.2)
C
C  CURRENT TERMINUS IS NEXT ORIGIN
      XX=X
      YY=Y
C
C  IF NO SIDE WAS INTERSECTED, INCREMENT TO THE NEXT SEGMENT.
      IF(NUM.EQ.0)GO TO 2
C
C  COMPUTE THE ENCLOSED AREA FROM EXIT NODE TO ENTRY NODE:
C
    9 IEXIT = ISIDE
      CALL WRAPUP(ISIDE,X,Y,IENTER,XENTER,YENTER,XM,YM,XP,YP,AREA(I1,J1)
     1)
      IF(IENTER.NE.0)CALL NETBAL(AREA(I1,J1),UNITAR)
C
C  A TRICK TO FLAG BOUNDARY CELLS WITH CONTAINED AREA EQUAL TO
C  UNITAR TO DISTINGUISH BOUNDARY CELLS FROM INTERIOR CELLS.
      IF(AREA(I1,J1).EQ.UNITAR)AREA(I1,J1)=.999*UNITAR
C        PRINT1010,L,I1,J1,IENTER,XENTER,YENTER,IEXIT,XX,YY,X,Y,AREA(I1,J1
C
C  HAVE ALL COUNTY OUTLINE SEGMENTS BEEN PROCESSED?
      IF(L.GT.NUMSEG)GO TO 100
C
C  DETERMINE NEXT CELL TO TRACK TO.
C
```

```
      XENTER=X
      YENTER=Y
C      PRINT 1003,L,I1,J1,IENTER,IEXIT
 1003 FORMAT(/' 9 WRAPUP L,I1,J1,IENTER,IEXIT',5I5)
C
C  TEST FOR PROCESSING NEXT SEGMENT = COINCIDENCE OF TERMINAL NODE
C  AND EXIT NODE = WITHIN EPS OF EACH OTHER.
      IF(ABS(X2(L)-X).LT.EPS.AND.ABS(Y2(L)-Y).LT.EPS)L=L+1
C
      IF(L.LE.NUMSEG)CALL ASTORE(&15,DELX,X2(L)-X,DELY,Y2(L)-Y,D,D,D,D)
      IF(L.GT.NUMSEG)CALL ASTORE(&15,DELX,X2(1)-X,DELY,Y2(1)-Y,D,D,D,D)
   15 CALL DECIDE(NUM,SIDE,DELX,DELY,JDEL,IDEL,IENTER)
      JNEXT=J1+JDEL
      INEXT=I1+IDEL
C      PRINT 1005,L,INEXT,JNEXT,IENTER,IEXIT
 1005 FORMAT(/ ' L INEXT JNEXT IENTER IEXIT'/5I4)
C
C  DETERMINE CELLS INTERIOR AND EXTERIOR TO (I1,J1)--(INEXT,JNEXT)
C  ON CELL ROW I1.
C
      IF(JDEL.EQ.0.AND.IDEL.EQ.0)GO TO 20
      CALL NTRIOR(AREA,DIMENY,DIMENX,I1,J1,IDEL,JDEL,JGO,JKWIT
     1, UNITAR, IGO, IKWIT)
      FIRSTM=.TRUE.
C      PRINT 1106,I1,J1,(AREA(I1,KJ),KJ=JGO,JKWIT)
      IF(AREA(I1,J1).GT.UNITAR.AND.AREA(I1,J1).LT.0.)FIRSTM=.FALSE.
   20 I1=INEXT
      J1=JNEXT
 1106 FORMAT(1X2I4,20F6.3,10(/9X20F6.3))
      IEXIT=0
      ISIDE=0
C      PRINT 1004, L,I1,J1
 1004 FORMAT(/' GOING TO 3 L I1 J1',3I5)
C  PROCESS NEXT CELL
      IF(L.LE.NUMSEG)GO TO 3
      IF(L.GT.NUMSEG)GO TO 9
C
```

```
C  100 = HAVE FINISHED TRACK FOR THIS COUNTY.
C
C  MAKE FINAL DETERMINATION OF CELLS EXTERIOR TO BOUNDARY CELLS AND
C  CONVERT NEGATIVE AREA VALUES TO POSITIVE.
  100  CALL FINAL(AREA,DIMENY,DIMENX,UNITAR,IGO,IKWIT,JGO,JKWIT)
C
       RETURN
       END
```

```
      SUBROUTINE REORDR(NUMSEG,X1,Y1,X2,Y2)                             00002530
      DIMENSION X1(20),Y1(20),X2(20),Y2(20)                             00002540
      MID=(NUMSEG+1)/2                                                  00002550
      I=1                                                               00002560
      J=NUMSEG                                                          00002570
      DO 1 L=1,MID                                                      00002580
      S1=X1(I)                                                          00002590
      S2=Y1(I)                                                          00002600
      S3=X2(I)                                                          00002610
      S4=Y2(I)                                                          00002620
      X1(I)=X2(J)                                                       00002630
      Y1(I)=Y2(J)                                                       00002640
      X2(I)=X1(J)                                                       00002650
      Y2(I)=Y1(J)                                                       00002660
      X2(J)=S1                                                          00002670
      Y2(J)=S2                                                          00002680
      X1(J)=S3                                                          00002690
      Y1(J)=S4                                                          00002700
      I=I+1                                                             00002710
    1 J=J-1                                                             00002720
      RETURN                                                            00002730
      END                                                               00002740
      SUBROUTINE SIDEIT(XM,XP,YM,YP,X1,Y1,X2,Y2,X,Y,ISIDE,NUM,SIDE)     00001470
C                                                                       00001480
C  'SIDEIT' IS CALLED BY 'TRACKR' TO FIND INTERSECTIONS OF SEGMENTS     00001490
C  AND CELL SIDES TO DETERMINE COORDINATES OF THE POINT WHERE THE       00001500
COUNTY BOUNDARY LEAVES THE CELL.                                        00001510
C  SUBROUTINES USED:                                                    00001520
C       SUBROUTINE YOFX                                                 00001530
C       SUBROUTINE XOFY                                                 00001540
C       SUBROUTINE NSTORE                                               00001550
C                                                                       00001560
       LOGICAL SIDE(4)                                                  00001570
C                                                                       00001580
      COMMON /IPARM/UNITAR,ISHIFT,XMAXD,YMAXD,EPS                       00001590
C                                                                       00001600
      XMIN=AMIN1(X1,X2)                                                 00001610
      XMAX=AMAX1(X1,X2)                                                 00001620
      YMIN=AMIN1(Y1,Y2)                                                 00001630
      YMAX=AMAX1(Y1,Y2)                                                 00001640
C                                                                       00001650
C  TEST SEGMENT L FOR INTERSECTION WITH SIDES OF CELL (I1,J1)           00001660
C     INITIALIZE COORDINATES OF INTERSECTION, THE SIDE NUMBER AND       00001670
C     THE NUMBER OF SIDES INTERSECTED.  TWO SIDES INTERSECTED MEANS     00001680
C     LEAVING THE CELL THROUGH A CORNER.                                00001690
C                                                                       00001700
      X=X2                                                              00001710
      Y=Y2                                                              00001720
      ISIDE=0                                                           00001730
      NUM=0                                                             00001740
C                                                                       00001750
C  TEST FOR TERMINAL NODE (X2,Y2) THIS SEGMENT BEING STRICTLY           00001760
C  INTERIOR TO THIS CELL AND THEREFORE NO INTERSECTION.                 00001770
      IF(X2.GT.XM.AND.X2.LT.XP.AND.Y2.GT.YM.AND.Y2.LT.YP)               00001780
     1 RETURN                                                           00001790
C                                                                       00001800
C  TEST FOR INTERSECTIONS WITH SIDES 1 & 3.  SOLVE FOR Y WITH X=XM      00001810
C  THEN WITH X=XP.                                                      00001820
      XB=XM                                                             00001830
      DO 5 KSIDE=1,3,2
      SIDE(KSIDE)=.FALSE.
C
C  FIND Y COORDINATE OF INTERSECTION OF SEGMENT AND THE SIDE NUMBER
C  'KSIDE'.
C
      CALL YOFX(XB,X1,Y1,X2,Y2,YB)
C
C  IS THE Y-COORDINATE OF INTERSECTION ON THE SIDES OF THE CELL?
C
      IF(YB.LE.YP.AND.YB.GE.YM.AND.XB.GE.XMIN.AND.XB.LE.XMAX)
     1      SIDE(KSIDE)=.TRUE.
C  THE ENTRY NODE IS AN UNWANTED POSSIBLE SOLUTION.
C
C  IS THE POINT OF INTERSECTION THE ENTRY POINT?
C
      IF(ABS(XB-X1).LT.EPS.AND.ABS(YB-Y1).LT.EPS)
     1      SIDE(KSIDE)=.FALSE.
      IF(.NOT.SIDE(KSIDE))GO TO 5
C
C  GO TO NEXT SIDE AND TEST IT FOR INTERSECTION.
C
      ISIDE=KSIDE
      Y=YB
      X=XB
      NUM=NUM+1
    5 XB=XP
C
C  TEST FOR INTERSECTION WITH SIDES 2 AND 4.  SOLVE FOR X WITH Y=YM THEN
C  Y=YP.
C
      YA=YM
      DO 6 KSIDE=2,4,2
      SIDE(KSIDE)=.FALSE.
      CALL XOFY(YA,X1,Y1,X2,Y2,XA)
      IF(XA.LE.XP.AND.XA.GE.XM.AND.YA.GE.YMIN.AND.YA.LE.YMAX)
     1      SIDE(KSIDE)=.TRUE.
```

```
C  THE ENTRY NODE IS AN UNWANTED POSSIBLE SOLUTION.                      00002210
      IF(ABS(XA-X1).LT.EPS.AND.ABS(YA-Y1).LT.EPS)                        00002220
     1       SIDE(KSIDE)=.FALSE.                                         00002230
      IF(.NOT.SIDE(KSIDE))GO TO 6                                        00002240
      ISIDE=KSIDE                                                        00002250
      X=XA                                                               00002260
      Y=YA                                                               00002270
      NUM=NUM+1                                                          00002280
    6 YA = YP                                                            00002290
C                                                                        00002300
      IF(NUM.GT.0)RETURN                                                 00002310
C  IF NO INTERSECTIONS THE SEGMENT (X1,Y1) TO (X2,Y2) MAY BE             00002320
C  COINCIDENT WITH A SIDE OF THE CELL AND (X2,Y2) MAY BE ON A            00002330
C  SIDE.                                                                 00002340
C                                                                        00002350
C  ARE WE ON A VERTICAL SIDE?                                            00002360
C                                                                        00002370
      IF(ABS(X2-X1).GT.EPS)GO TO 9                                       00002380
      IF(X2.EQ.XM.AND.(Y2.LE.YP.AND.Y2.GE.YM))SIDE(1)=.TRUE.             00002390
      IF(SIDE(1))CALL NSTORE(&8,ISIDE,1,NUM,NUM+1)                       00002400
    8 IF(X2.EQ.XP.AND.(Y2.LE.YP.AND.Y2.GE.YM))SIDE(3)=.TRUE.             00002410
      IF(SIDE(3))CALL NSTORE(&9,ISIDE,3,NUM,NUM+1)                       00002420
C                                                                        00002430
C  ARE WE ON A HORIZONTAL SIDE?                                          00002440
C                                                                        00002450
    9 IF(ABS(Y2-Y1).GT.EPS)GO TO 11                                      00002460
      IF(Y2.EQ.YM.AND.(X2.LE.XP.AND.X2.GE.XM))SIDE(2)=.TRUE.             00002470
      IF(SIDE(2))CALL NSTORE(&10,ISIDE,2,NUM,NUM+1)                      00002480
   10 IF(Y2.EQ.YP.AND.(X2.LE.XP.AND.X2.GE.XM))SIDE(4)=.TRUE.             00002490
      IF(SIDE(4))CALL NSTORE(&11,ISIDE,4,NUM,NUM+1)                      00002500
   11 IF(NUM.GT.0) RETURN                                                00002510
C                                                                        00002511
C  NO SIDES INTERSECTED AND TERMINAL NODE OF SEGMENT NOT INTERIOR TO     00002512
C  CELL.  SEGMENT MAY ORIGINATE ON A CELL SIDE AND BE DIRECTED AWAY FROM00002513
C  THE CELL.                                                             00002514
C                                                                        00002515
      IF(ABS(Y1-YM).LT.EPS) SIDE(2) = .TRUE.                             00002516
   IF(SIDE(2))CALL NSTORE(&12,ISIDE,2,NUM,NUM+1)                    00002517
12 IF(ABS(X1-XM).LT.EPS) SIDE(1) = .TRUE.                           00002518
   IF(SIDE(1))CALL NSTORE(&13,ISIDE,1,NUM,NUM+1)                    00002519
13 IF(NUM.EQ.0) RETURN                                              00002520
   X = X1                                                           00002521
   Y = Y1                                                           00002522
   RETURN                                                           00002523
   END                                                              00002524
```

```
      SUBROUTINE WRAPUP(IOUT,XOUT,YOUT,IENTER,XENTER,YENTER,XM,YM,XP,YP,
     1 AREA)
C
C  'WRAPUP' COMPUTES THE SEGMENTS AND THE TRAPEZOIDAL AREA UNDER THEM
C  GOING COUNTER CLOCKWISE ON THE SIDES OF A CELL FROM THE EXIT NODE ON
C  SIDE IOUT TO THE ENTRY NODE ON SIDE IENTER.
C  THE INDIVIDUAL AREAS, TMPARE, ARE ADDED TO THE CUMULATIVE SUM OF THE
C  CONTAINED AREA OF THE CURRENT CELL.
C
C  XENTER AND YENTER ARE THE COORDINATES OF THE ENTRY NODE.
C  XM, YM, XP, YP ARE THE CORNER COORDINATES OF THE CELL.
C  SIDE NUMBER 1 IS THE 'WESTERN' SIDE OF THE CELL.  THE OTHER SIDES ARE
C  NUMBERED SEQUENTIALLY COUNTER-CLOCKWISE FROM SIDE 1.
C
C
C  THE CELL TRANSECTED BY THE FIRST SEGMENT IN THE LIST CAN NOT BE
C  WRAPPED UP UNTIL THE LAST SEGMENT IN THE LIST IS ENCOUNTERED.
C
      LOGICAL FINISH
C
C  FIRST SEGMENT IN THE BOUNDARY
C
      IF(IENTER.NE.0)GO TO 100
      XSAVE = XOUT
      YSAVE = YOUT
      ISAVE = IOUT
      RETURN
  100 IF(IOUT.NE.0)GO TO 101
C
C  FINAL SEGMENT IN THE BOUNDARY.
C
      XOUT=XSAVE
      YOUT=YSAVE
      IOUT=ISAVE
  101 ISIDE=IOUT
      FINISH=.FALSE.
C
```

```
C  BEGIN AT THE EXIT NODE:
C
C  INITIALIZE (X1,X2), (Y1,Y2) FOR EXIT ON SIDE 1
      IF(ISIDE.EQ.1)CALL ASTORE(&9,X1,XOUT,Y1,YOUT,X2,XM,Y2,YM)
C  INITIALIZE (X1,X2), (Y1,Y2) FOR EXIT ON SIDE 3
      IF(ISIDE.EQ.3)CALL ASTORE(&9,X1,XOUT,Y1,YOUT,X2,XP,Y2,YP)
C  INITIALIZE (X1,X2), (Y1,Y2) FOR EXIT ON SIDE 2
      IF(ISIDE.EQ.2)CALL ASTORE(&9,X1,XOUT,Y1,YOUT,X2,XP,Y2,YM)
C  INITIALIZE (X1,X2), (Y1,Y2) FOR EXIT ON SIDE 4
      IF(ISIDE.EQ.4)CALL ASTORE(&9,X1,XOUT,Y1,YOUT,X2,XM,Y2,YP)
C
C  EXIT SIDE AND ENTRY SIDE MAY BE THE SAME SIDE.
C
    9 IF(IENTER.NE.IOUT)GO TO 19
C
C  ENTRY AND EXIT SIDES ARE THE SAME SIDE.
C
C  THE AREA UNDER SEGMENTS ON SIDES 1 OR 3 IS ZERO; RETURN TO CALLING
C  PROGRAM WITHOUT ADDING TO CUMULATIVE AREA OF THE CURRENT CELL.
C
      GO TO (1,2,3,4),ISIDE
    1 IF(YOUT.LT.YENTER)GO TO 19
      RETURN
    2 IF(XOUT.GT.XENTER)GO TO 19
      FINISH=.TRUE.
      IMPARE =FAREA(XOUT,YOUT,XENTER,YENTER)
      GO TO 20
    3 IF(YOUT.GT.YENTER)GO TO 19
      RETURN
    4 IF(XOUT.LT.XENTER)GO TO 19
      IMPARE=FAREA(XOUT,YOUT,XENTER,YENTER)
      FINISH=.TRUE.
      GO TO 20
C
C
C  TRAVEL TO THE NEXT SIDE AFTER ISIDE HAS BEEN INCREMENTED 1.
C  THE AREA UNDER SEGMENTS ON SIDES 1 OR 3 IS ZERO.  BRANCH PAST THE
```

```
C  CUMULATIVE SUM AT STATEMENT 20
C
   10 GO TO (11,12,13,14),ISIDE
   11 CALL ASTORE(&21,X1,X2,Y1,Y2,X2,XM,Y2,YM)
   12 CALL ASTORE(&19,X1,X2,Y1,Y2,X2,XP,Y2,YM)
   13 CALL ASTORE(&21,X1,X2,Y1,Y2,X2,XP,Y2,YP)
   14 CALL ASTORE(&19,X1,X2,Y1,Y2,X2,XM,Y2,YP)
C
C  19 = COMPUTE AREA CONTAINED BY SEGMENT FROM (X1,Y1) TO (X2,Y2)
C
   19 TMPARE=FAREA(X1,Y1,X2,Y2)
C
C  ADD AREA CONTAINED BY SEGMENT TO AREA CONTAINED IN THIS CELL:
C
   20 AREA=AREA+TMPARE
   21 CONTINUE
C        PRINT 1000,ISIDE,X1,Y1,X2,Y2,TMPARE,AREA
C 1000 FORMAT(10XI3,5F10.2,F10.4)
      IF(FINISH)RETURN
C
C  ADVANCE TO NEXT SIDE:
C
      ISIDE=MOD(ISIDE,4)+1
      IF(ISIDE.NE.IENTER)GO TO 10
      FINISH=.TRUE.
      CALL ASTORE(&19,X1,X2,Y1,Y2,X2,XENTER,Y2,YENTER)
C
C  NET BALANCE COMPUTATION ON CONTAINED AREA OF CELL.
      ENTRY NETBAL(AREA,UNITAR)
   30 IF(AREA.GE.UNITAR)RETURN
      AREA = AREA-UNITAR
      GO TO 30
      END
      SUBROUTINE DECIDE(NUM,SIDE,DELX,DELY,JDEL,IDEL,IENTER)
C
C  'DECIDE' THE INCREMENTS IDEL AND JDEL TO THE CURRENT
C  CELL INDICES I1, J1, AND THE ENTRY SIDE OF THE NEXT CELL.
C
      LOGICAL SIDE(4)
      DIMENSION IINC(3,3), JINC(3,3)
      INTEGER ENTER1(3,3), ENTER2(3,3), ENTER3(3,3), ENTER4(3,3)
      DATA IINC/-1,-1,-1,-1,999,0,0,0,0/,
     1     JINC/-1,0,0,-1,999,0,-1,-1,0/,
     2     ENTER1/4,1,1,4,999,1,2,2,1/,
     3     ENTER2/3,4,4,3,999,2,3,3,2/,
     4     ENTER3/3,1,1,3,999,1,3,3,1/,
     5     ENTER4/4,4,4,4,999,2,2,2,2/
C
C  DETERMINE THE I AND J SUBSCRIPTS TO ENTER THE TABLES WITH.
C
      JDEL=0
      IDEL=0
      IF(DELX)1,2,3
    1 I=1
      GO TO 4
    2 I=2
      GO TO 4
    3 I=3
    4 IF(DELY)5,6,7
    5 J=1
      GO TO 8
    6 J=2
      GO TO 8
    7 J=3
    8 IF(NUM.EQ.1)GO TO 10
      IDEL=IINC(I,J)
      IF((SIDE(1).OR.SIDE(3)).AND.SIDE(4))IDEL=IDEL+1
      JDEL=JINC(I,J)
      IENTER=ENTER1(I,J)
      IF(.NOT.((SIDE(2).OR.SIDE(4)).AND.SIDE(3)))RETURN
      JDEL=JDEL+1
      IENTER=ENTER2(I,J)
      RETURN
   10 IF(SIDE(1))CALL NSTORE(&11,JDEL,JINC(I,J),IENTER,ENTER3(I,J))
      IF(SIDE(2))CALL NSTORE(&11,IDEL,IINC(I,J),IENTER,ENTER4(I,J))
      IF(SIDE(3))CALL NSTORE(&11,JDEL,JINC(I,J)+1,IENTER,ENTER3(I,J))
      IF(SIDE(4))CALL NSTORE(&11,IDEL,IINC(I,J)+1,IENTER,ENTER4(I,J))
   11 RETURN
      END
      SUBROUTINE NTRIOR(AREA,DIMENY,DIMENX,I1,J1,IDEL,JDEL,JGO,JKWIT,
     1 UNITAR, IGO, IKWIT)
C
C  'NTRIOR' IS CALLED BY SUBR. TRACKER AFTER THE FIRST WRAP-UP OF A
C  BOUNDARY CELL TO DETERMINE THE CELLS INTERIOR AND EXTERIOR TO
C  IT AND THE NEXT BOUNDARY CELL IF THE NEXT CELL IS NOT THE CURRENT
C  CELL.
C
      INTEGER DIMENY, DIMENX
      DIMENSION AREA(DIMENY,DIMENX)
C
C  INITIALIZE THE J-INCREMENT:
      JINC=0
      IF(IDEL.EQ.0)GO TO 13
      JINC = -ISIGN(1,IDEL)
      JJ=J1
C
C  DETERMINE THE INTERIOR CELLS ON ROW I1:
   10 JJ=JJ+JINC
      IF(JJ.LT.JGO.OR.JJ.GT.JKWIT)GO TO 11
      IF(AREA(I1,JJ).EQ.0.)AREA(I1,JJ)=UNITAR
      IF(AREA(I1,JJ).EQ.UNITAR)GO TO 10
C
C  DETERMINE THE EXTERIOR CELLS ON ROW I1:
   11 JINC=-JINC
      JJ=J1
   12 JJ=JJ+JINC
      IF(JJ.LT.JGO.OR.JJ.GT.JKWIT)GO TO 13
      IF(AREA(I1,JJ).EQ.UNITAR)AREA(I1,JJ)=0.
      IF(AREA(I1,JJ).EQ.0.)GO TO 12
   13 IF(JDEL.EQ.0)RETURN
      IINC = ISIGN(1,JDEL)
C  DETERMINE THE INTERIOR CELLS IN COLUMN J1:
      II=I1
   14 II = II + IINC
      IF(II.LT.IGO.OR.II.GT.IKWIT)GO TO 15
      IF(AREA(II,J1).EQ.0.)AREA(II,J1) = UNITAR
      IF(AREA(II,J1).EQ.UNITAR) GO TO 14
   15 IINC = -IINC
      II = I1
   16 II = II+IINC
      IF(II.LT.IGO.OR.II.GT.IKWIT)RETURN
      IF(AREA(II,J1).EQ.UNITAR) AREA(II,J1) = 0.
      IF(AREA(II,J1).EQ.0.)GO TO 16
      RETURN
C
      ENTRY FINAL(AREA,DIMENY,DIMENX,UNITAR,IGO,IKWIT,JGO,JKWIT)
      INTEGER DIMENY,DIMENX
      DIMENSION AREA(DIMENY,DIMENX)
C
C  'FINAL' IS CALLED BY 'TRACKER' AFTER THE TRACK OF A COUNTY BOUNDARY
C  THROUGH THE GRID CELL ARRAY IS COMPLETED.  'FINAL' MAKES THE FINAL
C  DETERMINATION OF CELLS EXTERIOR TO THE BOUNDARY CELLS.
C  THE PRINCIPLE IS THAT ALL CELLS ON A GIVEN ROW (OR COLUMN) BETWEEN
C  THE ENCLOSING RECTANGLE AND THE FIRST OCCURRENCE OF A BOUNDARY CELL
C  ON THAT ROW (OR COLUMN) ARE EXTERIOR TO THE BOUNDARY.
C
C  FIRST FINISH DETERMINATION OF INTERIOR CELLS.
C
      IG1 = IGO+1
      JG1 = JGO+1
      IKW = IKWIT-1
      JKW = JKWIT - 1
      DO 30 I=IG1,IKW
      DO 30 J=JG1,JKW
      IF(AREA(I,J).NE.0.)GO TO 30
      IF(AREA(I,J-1).EQ.UNITAR)AREA(I,J)=UNITAR
      IF(AREA(I-1,J).EQ.UNITAR)AREA(I,J)=UNITAR
      IF(AREA(I,J+1).EQ.UNITAR)AREA(I,J)=UNITAR
      IF(AREA(I+1,J).EQ.UNITAR)AREA(I,J)=UNITAR
   30 CONTINUE
C      PRINT 66,IGO,IKWIT,JGO,JKWIT
C   66 FORMAT(/'  SUBROUTINE FINAL.  IGO,IKWIT,JGO,JKWIT =',4I10)
      DO 1 I=IGO,IKWIT
      DO 2 J=JGO,JKWIT
      IF(AREA(I,J).GT.UNITAR.AND.AREA(I,J).LT.0.)GO TO 3
    2 AREA(I,J)=0.
    3 J=JKWIT
      DO 4 JJ=JGO,JKWIT
      IF(AREA(I,J).GT.UNITAR.AND.AREA(I,J).LT.0.)GO TO 1
      AREA(I,J)=0.
    4 J=J-1
    1 CONTINUE
C
C  WORK FROM VERTICAL SIDES JGO AND JKWIT.
      DO 9 J=JGO,JKWIT
      DO 5 I=IGO,IKWIT
      IF(AREA(I,J).GT.UNITAR.AND.AREA(I,J).LT.0.)GO TO 6
    5 AREA(I,J)=0.
    6 I=IKWIT
      DO 7 II=IGO,IKWIT
      IF(AREA(I,J).GT.UNITAR.AND.AREA(I,J).LT.0.)GO TO 9
      AREA(I,J)=0.
    7 I=I-1
    9 CONTINUE
C
C  CONVERT NEGATIVE AREA VALUE TO POSITIVE AND RESET BOUNDARY
C  CELLS WITH AREA .999 (TRICK VALUE) TO 1.0
      DO 20 I=IGO,IKWIT
      DO 20 J=JGO,JKWIT
      IF(AREA(I,J).EQ..999)AREA(I,J)=UNITAR
   20 IF(AREA(I,J).LT.0)AREA(I,J)=-AREA(I,J)
      RETURN
      END
      SUBROUTINE PROXPR  (F,DIMENY,DIMENX,IGO,IKWIT,JGO,JKWIT,A,B,C)     00000060
C                                                                       00000010
C  TO PRINT SYMBOLS FOR NUMERICAL VALUES TO SHOW COUNTY OUTLINES AND    00000030
C  INTERIORS.                                                           00000040
C                                                                       00000050
      LOGICAL LINE(100), BLANK/'    '/, ASTER/'****'/, ONE/'IIII'/      00000070
      INTEGER DIMENY,DIMENX                                             00000080
      DIMENSION F(DIMENY,DIMENX)                                        00000090
      COMMON/IOFILE/NR,NP,NPUNCH,NIN1,NIN2,NOUT1,NOUT2                  00000100
C                                                                       00000110
      JG = JGO                                                          00000120
   10 JK = JG + 100                                                     00000130
      IF(JK.GT.JKWIT)JK=JKWIT                                           00000140
      L=1                                                               00000150
      WRITE(NP,4)((L,M=1,10),L=1,9)                                     00000160
    4 FORMAT(13X100I1)                                                  00000170
      WRITE(NP,3) ((L,L=1,10),M=1,10)                                   00000180
    3 FORMAT(4X100I1)                                                   00000190
      I = IKWIT                                                         00000200
      DO 5 II=IGO,IKWIT                                                 00000210
      L=0                                                               00000220
      DO 1 J=JG,JK                                                      00000230
      L=L+1                                                             00000240
      LINE(L) = ASTER                                                   00000250
      IF(F(I,J).EQ.A) LINE(L) = BLANK                                   00000260
    1 IF(F(I,J).GE.C) LINE(L) = ONE                                     00000270
C  USAGE (EXAMPLE) A B C = EXTERIOR BOUNDARY INTERIOR = BLANK * I       00000280
C                                                                       00000290
      M=L                                                               00000300
      WRITE(NP,2) I, (LINE(L),L=1,M)                                    00000310
    2 FORMAT(I4,100A1)                                                  00000320
    5 I=I-1                                                             00000330
      JG = JK + 1                                                       00000340
      IF(JG.LE.JKWIT)GO TO 10                                           00000350
      RETURN                                                            00000360
      END                                                               00000370
```

Reproduced from
best available copy.

```
      SUBROUTINE INPOP(F,DIMENY,DIMENX,IGO,IKRIT,JGO,JKRIT,TOTPOP,TOTHOS00000090
     1 ,NPCNTL, ISTATE, ICOUNT)                                         00000100
      INTEGER F, DIMENY,DIMENX                                          00000110
C*****                                                                  00000010
C     THIS PROGRAM READS THE EXTRACTED AUCR-TAPE, CONTAINING UTM-COORDS,00000030
C     FROM CAASE1.                                                      00000040
C  THE DIMENSIONS OF ARRAY KF MUST BE REVERSED FROM THOSE OF ARRAY F IN 00000050
C  THE CALLING PROGRAM TO PERMIT COINCIDENT VARIATION BETWEEN THE FIRST 00000060
C  SUBSCRIPT AND THE X-COORDINATE                                       00000070
C                                                                       00000080
      DIMENSION F(DIMENX,DIMENY)                                        00000120
C                                                                       00000130
C  INITIALIZE CUMULATIVE SUMS FOR ALL COUNTIES:                         00000140
      DATA IFST/0/, KREC/0/, IFILE/0/, SUMPOP/0./, SUMHOS/0./           00000150
C                                                                       00000160
      COMMON /VECFO/ AUCR(5), STATE(5,10), CNTY(5,15), IDCO(15),        00000170
     1          NRECO(15), IY(2520),JX(2520),POP(2520),HOUS(2520)       00000180
     2          , AREA(2520)                                            00000190
C                                                                       00000200
      COMMON /LINFO/ NSTATE, NUMCO, NRECT, NX, NY, LTWO, GXMIN,         00000210
     1 GXMAX,GYMIN, GYMAX, XORIG, YORIG, MTUZ, ID, YASSUC               00000220
C                                                                       00000230
      COMMON /IOFILE/ NR, NP, NPUNCH, NIN1, NIN2, NOUT1, NOUT2          00000240
C                                                                       00000250
      COMMON/IPARM/  UNITAR, ISHIFT, XMAXD, YMAXD, EPS                  00000260
C                                                                       00000270
      IF(IFST.NE.0)GO TO 2                                              00000280
      IFST = 1                                                          00000290
C      WRITE(NP,103)IGO,IKRIT,JGO,JKRIT, XORIG, YORIG                   00000300
C  103 FORMAT(/'  SUBROUTINE INPOP.  IGO, IKRIT, JGO, JKRIT =',4I10/'   00000310
C     1XORIGN, YORIGN = ',2F20.5)                                       00000320
      NCNTY = NUMCO                                                     00000330
      IREAD=NR                                                          00000340
      IPRINT=NP                                                         00000350
C                                                                       00000360
      ITAPE = NIN2                                                      00000370
C                                                                       00000380
```

```
C
C  INITIALIZE FOR THIS 1 COUNTY.
C
   2 DO 1 I=IGO,IKWIT
     DO 1 J=JGO,JKWIT
   1 F(J,I)=0
     KREC = 0
     NMCNTL = 0
     TOTPOP = 0.
     TOTHOS = 0.
     IFILE = IFILE + 1
     IF(IFILE.EQ.1)GO TO 200
     GO TO 201
C
 5030 FORMAT(I2,2XI4,66XF7.0,F8.0,55X,2F15.2)
 5080 FORMAT (/,10X,'AUCR POPULATION DATA.',5A4/' TOTAL  # RECORDS
     1 READ:',I10/'  NUMBER OF RECORDS FOR THIS COUNTY:',I10)
C
C*****SET COUNTY RECORD INDICATOR.
C
C*****READ CAASE1 TAPE. WHEN AN EOF IS REACHED, MUST CHECK TO SEE IF ANY
C       MORE COUNTY FILES ARE ON THIS AUCR TAPE.
C
  200 READ(ITAP1,5030,END=600)KSTAT,KCNTY,THOUS,TPOP,TXOUT,TYOUT
C
C  TOTALS FOR ALL COUNTIES
     KREC = KREC+1
     SUMPOP = SUMPOP + TPOP
     SUMHOS = SUMHOS + THOUS
  201 IF(KSTAT.NE.ISTATE.OR.KCNTY.NE.ICOUNT)GO TO 600
C      PRINT 1617,KSTAT,KCNTY,THOUS,TPOP,TXOUT,TYOUT
C 1617 FORMAT(2I10,4F20.5)
     JSTAT = KSTAT
     JCNTY = KCNTY
     XHOUS = THOUS
     XPOP = TPOP
     XOUT = TXOUT
```

```
      YOUT = IYOUT                                                      00000760
      NREC = NREC+1                                                     00000770
      TOTPOP = TOTPOP + XPOP                                            00000780
      TOTHUS = TOTHUS + XHOUS                                           00000790
      X = XOUT-XORIG                                                    00000800
      Y = YOUT-YORIG                                                    00000810
      I=Y                                                               00000820
      J=X                                                               00000830
      IF(I.LT.IGO)GO TO 200                                             00000840
      IF(I.GT.IKWIT)GO TO 200                                           00000850
      IF(J.LT.JGO)GO TO 200                                             00000860
      IF(J.GT.JKWIT)GO TO 200                                           00000870
      IPOP = XPOP                                                       00000880
      IHOUS = XHOUS                                                     00000890
C      PRINT 1616,KREC,I,J,IPOP,IHOUS                                   00000900
 1616 FORMAT(5I10)                                                      00000910
C  STORE THE POPULATION AND HOUSING VALUES FOR THIS CENSUS E.D. IN THE  00000920
C  CENSUS CELL (J,I), J AND I CORRESPONDING TO TRUNCATED COORDINATES    00000930
C  X AND Y OF THE CENSUS E.D.                                           00000940
      F(J,I) = (IPOP*ISHIFT + IHOUS) + F(J,I)                           00000950
      GO TO 200                                                         00000960
C                                                                       00000970
C*****HAVE REACHED END OF COUNTY # 'ICOUNT' OR AN EOF ON THE INPUT TAPE.00000980
C                                                                       00000990
  600 IFILE= IFILE+1                                                    00001000
C                                                                       00001010
C*****THE COUNTY HAS BEEN COMPLETED.                                    00001020
C                                                                       00001030
      WRITE(IPRINT,5080) AGCR,KREC,NREC                                 00001040
C                                                                       00001050
C                                                                       00001060
C  PLACE POPULATION DATA IN VECTOR STORAGE RANK-ORDERED (SORTED) ON     00001070
C  X-COORDINATE (PRIMARY), Y-COORDINATE(SECONDARY) BOTH INCREASING.     00001080
C  CRITICAL FOR SUBSEQUENT DIRECT SEARCH USED TO CONSTRUCT PROXIMAL MAP 00001090
      L=0                                                               00001100
      DO 20 I=IGO,IKWIT                                                 00001110
      DO 20 J=JGO,JKWIT                                                 00001120
      IF(F(J,I).LE.0)GO TO 20
      L=L+1
      POP(L) = F(J,I)/ISHIFT
      IPOP = POP(L) + 0.5
      HOUS(L) = F(J,I)-IPOP*ISHIFT
C
C  THIS STEP DETERMINES TOTAL POPULATION AND HOUSING ASSOCIATED WITH THE
C  L-TH. CENSUS CELL.  THE AREA ASSOCIATED WITH THE L-TH. CELL WILL BE
C  DETERMINED FROM THE PROXIMAL MAP.
C
      IY(L) = I
      JX(L) = J
C      PRINT 1610,L,I,J,POP(L),HOUS(L)
C 1610 FORMAT(3I5,2E12.5)
   20 CONTINUE
 1000 NMCNTL = L
      RETURN
      END
      SUBROUTINE PROXML(F,DIMENY,DIMENX,IGO,IKWIT,JGO,JKWIT,LGO,NMCNTL)
      INTEGER DIMENY, DIMENX
      DIMENSION F(DIMENY,DIMENX), LGO(DIMENY)
      COMMON /VECFO/ AOCR(5), STATE(5,10), CNTY(5,15), IDCO(15),
     1         NRECO(15),ICNTL(2520),JCNTL(2520),POP(2520),HOUS(2520)
     2         , AREA(2520)
      COMMON /LINFO/ NSTATE, NUMCO, NRECT, NX, NY, LTWO, GXMIN,
     1       GXMAX, GYMIN, GYMAX, XORIG, YORIG, MTUZ, ID, YASSOC
      COMMON /IOFILE/ NR, NP, NPUNCH, NIN1, NIN2, NOUT1, NOUT2
      COMMON/IPARM/  UNITAR, ISHIFT, XMAXD, YMAXD, EPS, MAXSQR
C
C       PRINT 1401, NMCNTL
 1401 FORMAT(/' PROXIMAL.  NMCNTL CELLS:  ',I10)
C  IDENTIFY AND FLAG CONTROL CELLS IN THE GRID CELL ARRAY F(I,J).
      L=0
      DO 20 LL=1,NMCNTL
      I=ICNTL(LL)
      J=JCNTL(LL)
C
C  IS THE LL-TH. CONTROL CELL INSIDE THE COUNTY BOUNDARY?
      IF(F(I,J).NE.0.)GO TO 4
C
C  CONTROL CELL # LL IS OUTSIDE THE COUNTY.  REMOVE IT FROM THE LIST.
      WRITE(NP,1601)LL,I,J, POP(LL), HOUS(LL)
 1601 FORMAT(' SUBROUTINE PROXIMAL.  CELL # ',I4,', I,J COORDINATES ',2I
     14,', IS OUTSIDE THE BOUNDARY OF THIS COUNTY.'/' ITS POPULATION AND
     1 HOUSING COUNTS ARE:',2F10.0)
      GO TO 20
    4 L=L+1
      ICNTL(L) = ICNTL(LL)
      JCNTL(L) = JCNTL(LL)
      AREA(L) = F(I,J)
      POP(L) = POP(LL)
      HOUS(L) = HOUS(LL)
      F(I,J) = -L
   20 CONTINUE
      NMCNTL = L
      DO 5 J=JGO,JKWIT
      DO 5 I=IGO,IKWIT
    5 IF(F(I,J).NE.0.)F(I,J)=-F(I,J)
      AREA(NMCNTL+1)=0
C
C
      CALL SETLGO(IGO,IKWIT,NMCNTL,LGO)
C
C  FIND THE CONTROL CELL NEAREST EACH NON-CONTROL CELL (I,J).
C  STORE THE INDEX OF THE NEAREST CONTROL CELL IN F(I,J).
C
      CALL SEARCH(F,DIMENY,DIMENX,IGO,IKWIT,JGO,JKWIT,LGO, NMCNTL)
C
C  COMPUTE DENSITY FOR EACH CONTROL CELL BASED ON TOTAL AREA OF NEAREST
C  NEIGHBORS ASSOCIATED WITH IT.
C
      DO 22 L=1,NMCNTL
C      PRINT 1615, L, AREA(L), POP(L), HOUS(L)
 1615 FORMAT(I5,3E12.5)
      IF(AREA(L).EQ.0.)GO TO 22
      POP(L) = POP(L)/AREA(L)
      HOUS(L) = HOUS(L)/AREA(L)
C      PRINT 1616, POP(L), HOUS(L)
 1616 FORMAT(1H+,41X2E12.5)
   22 CONTINUE
C
      RETURN
      END
      SUBROUTINE SEARCH(F,DIMENY,DIMENX,IGO,IKWIT,JGO,JKWIT,LGO,NMCNTL)
C
C  RTI.C44.PU1303.JWD.SEARCH.FORT
C  CONSTRUCT THE PROXIMAL MAP OF F(I,J)
C  GIVEN THE  ARRAY F(I,J) AND BOUNDARIES WITHIN F,
C  F IS DEFINED AT VARIOUS CONTROL CELLS.  SEARCH FROM NON CONTROL
C  CELL  (I,J) TO FIND NEAREST CONTROL CELL.
C
C  THE SEARCH ABOUT (I,J) IS CONSTRAINED TO THE RECTANGLE DEFINED BY
C  RS, THE DISTANCE FROM (I,J) TO THE CONTROL CELL NEAREST THE ADJACENT
C  CELL, (I,J-1).
C
C  THE L-TH. CONTROL CELL HAS COORDINATES IY(L), JX(L).
C
C  ARRAY F(I,J) WILL BE RETURNED CONTAINING VALUES OF CONTROL CELL
C  INDICES:  F(I,J) = L = THE INDEX OF THE CONTROL CELL NEAREST (I,J).
C
C
      INTEGER DIMENY, DIMENX
      DIMENSION F(DIMENY,DIMENX), LGO(DIMENY)
      COMMON /VECFO/ AGCR(5), STATE(5,10), CNTY(5,15), IDCO(15),
     1       NRECO(15), IY(2520), JX(2520), POP(2520), HOUS(2520)
     2       , AREA(2520)
      COMMON /LINFO/ NSTATE, NUMCO, NRECT, NX, NY, LTWO, GXMIN,
     1       GXMAX, GYMIN, GYMAX, XORIG, YORIG, MTUZ, ID, YASSOC
      COMMON /IOFILE/ NR, NP, NPUNCH, NIN1, NIN2, NOUT1, NOUT2
      COMMON/IPARM/UNITAR,ISHIFT,XMAXD,YMAXD,EPS,MAXSQR
C*****
C
C  BEGIN SEARCH FOR NEAREST NEIGHBORS
C
      MAXR = XMAXD**2 + YMAXD**2
      LSAV1 = 1
      DO 10 I=IGO, IKWIT
C  THE DISTANCE (SQUARED) FROM CELL (I,J) TO THE CONTROL CELL NEAREST
C  THE PEVIOUS I,J CELL.
C        PRINT 200,I,LSAV1
```

```
  200 FORMAT(/' SEARCH.  I  LSAV1',2I5)
      RS = (I-IY(LSAV1))**2+(JGO-JX(LSAV1))**2
C        PRINT 199, IY(LSAV1), JX(LSAV1), RS
  199 FORMAT(/' IY(LSAV1)  JX(LSAV1)  RS',2I5,E12.5)
      DO 8 J=JGO,JKWIT
C
C  (I,J) MAY BE OUTSIDE BOUNDARIES:  F(I,J)=0
C        MAY BE A CONTROL CELL:  F(I,J) GT 0 (INDEX OF THE CONTROL CELL)
C        MAY BE UNASSIGNED:  F(I,J) LT 0.
C
C        PRINT 201,I,J,F(I,J)
  201 FORMAT(/' I  J  F(I,J)',2I5,E12.5)
      IF(F(I,J).GE.0.)GO TO 8
      RS = SQRT(RS)
C
C  INDICES OF THE RECTANGLE CONTAINING THE MAXIMUM SEARCH RADIUS, RS.
C
      JRMAX = J+RS+ 1
      JRMIN = J-(RS+1)
      IRMAX = I+RS+1
      IRMIN=I-RS-1
       IF(IRMIN.LT.IGO)IRMIN=IGO
      IF(JRMIN.LT.JGO)JRMIN=JGO
      IF(IRMAX.GT.IKWIT)IRMAX=IKWIT
      IF(JRMAX.GT.JKWIT)JRMAX=JKWIT
      LLGO = LGO(IRMIN)
      RSQMIN = MAXR
C        PRINT 202,IRMAX,IRMIN,JRMAX,JRMIN,LLGO
  202 FORMAT(/' IRMAX  IRMIN  JRMAX  JRMIN LLGO',5I5)
      DO 7 L=LLGO,NMCNTL
C        PRINT 203,L,IY(L),JX(L)
  203 FORMAT(/'  L  IY(L)  JX(L)',3I5)
       IF(IY(L).GT.IRMAX) GO TO 77
      IF(JX(L).GT.JRMAX)GO TO 7
      IF(JX(L).LT.JRMIN)GO TO 7
C
C  CONTROL CELL L IS IN   I+IRMAX,I-IRMIN,J+JRMAX,J-JRMIN
```

```
C
      IDEL=I-IY(L)
      JDEL = J-JX(L)
      RSQUAR=IDEL*IDEL+JDEL*JDEL
C       PRINT 204, IDEL, JDEL, RSQUAR, RSQMIN
  204 FORMAT(/'  IDEL  JDEL  RSQUAR  RSQMIN',2I5,2E12.5)
      IF(RSQUAR-RSQMIN)12,11,7
   11 CALL TIEBRK(RSQUAR,RSQMIN,&12,&7)
   12 RSQMIN=RSQUAR
      LSAV=L
      IF(J.EQ.JGO)LSAV1 = LSAV
C       PRINT 205, RSQMIN, LSAV, LSAV1, F(I,J)
  205 FORMAT(/' 12  RSQMIN  LSAV  LSAV1  F(I,J)',E12.5,2I5,E12.5)
    7 CONTINUE
C
C  F(I,J) CONTAINS NEGATIVE VALUE OF AREA OF CELL (I,J).
C  THE ALGEBRAIC SIGN OF F(I,J) IS NEGATIVE.  -F IS +.
C
C        PRINT 206, I,J,LSAV,F(I,J)
  206 FORMAT(/'  I,J  LSAV  F(I,J)',3I5,E12.5)
   77 CONTINUE
      AREA(LSAV)=AREA(LSAV) - F(I,J)
      F(I,J) = LSAV
C
C  COMPUTE THE DISTANCE FROM THE CONTROL CELL FOUND NEAREST (I,J) TO
C  THE NEXT CELL ADJACENT, (I,J+1).  THERE IS NO NEED TO SEARCH OVER
C  CONTROL CELLS GREATER THAN THIS DISTANCE AWAY FROM (I,J+1).
C
      RS = RSQMIN +  2.*(J-JX(LSAV))+ 1.
    8 CONTINUE
   10 CONTINUE
      RETURN
      ENTRY SETLGO(IGO,IKWIT,NMCNTL,LGO)
      DIMENSION LGO(1)
C  SETLGO COMPUTES VALUES FOR ARRAY LGO(I),I=IGO . . ., IKWIT.
C  SETLGO DETERMINES WHICH CONTROL CELL IS THE FIRST TO OCCUR ON A LINE
C  OF Y=CONSTANT.  THE INDEX OF THAT CONTROL CELL, L, IS STORED IN
```

```
C  ARRAY LGO(I) WHERE I = INTEGER OF Y=CONSTANT.                          00000750
C  FOR ALL VALUES OF I GREATER THAN Y UP TO THE NEXT LINE Y CONTAINING   00000760
C  A CONTROL CELL, LGO IS SET EQUAL TO L.                                 00000770
C  THE VALUES OF ARRAY LGO ARE USED IN SUBROUTINE 'SEARCH'.               00000780
      PRINT110,IGO,IKWIT,NMCNTL                                           00000785
  110 FORMAT(/'  SUBR. SETLGO.  IGO, IKWIT, NMCNTL =',3I10)               00000786
      IG=IGO                                                              00000790
      IYLAST=0                                                            00000800
      DO 2 L=1,NMCNTL                                                     00000810
C        PRINT111,L,IY(L),IYLAST,IK                                       00000812
  111 FORMAT('  L  IY(L)  IYLAST  IK',4I10)                               00000813
      IF(IY(L).EQ.IYLAST)GO TO 2                                          00000820
      IYLAST=IY(L)                                                        00000830
      IK=IYLAST                                                           00000840
      DO 1 I=IG,IK                                                        00000850
C        PRINT112,I, L                                                    00000852
  112 FORMAT(10X'LGO(',I3,') =',I4)                                       00000853
    1 LGO(I)=L                                                            00000860
      IG=IK+1                                                             00000870
    2 CONTINUE                                                            00000880
      DO 3 I=IK,IKWIT                                                     00000890
    3 LGO(I)=IYLAST                                                       00000900
      RETURN                                                              00000910
      END                                                                 00000920
```

```
SUBROUTINE TIEBRK(A,B,*,*)
IMPLICIT INTEGER (A-Z)
REAL ZZ
DATA NNN/123321/
CALL RANDU(NNN,NNN,ZZ)
IF(ZZ.GT.0.5)RETURN 1
RETURN 2
END
```

```
      SUBROUTINE GRIDIT(*,F,DIMENY,DIMENX,FMAX,ICOUNT,TOTPOP,TOTHOS,    00000010
     1 NUMSQR)                                                          00000020
C                                                                       00000030
C  RTI.C44.PU1303.JWD.GRIDDIT.FORT                                      00000040
C                                                                       00000050
C                                                                       00000060
C  PARTITION INITIAL GRID SQUARE SYSTEM OF SQUARES OF SIZE TWOL INTO    00000070
C  SMALLER SQUARES IF THE CONTAINED POPULATION (INTEGRAL OF F(I,J) OVER 00000080
C  THE SQUARE) EXCEEDS FMAX.                                            00000090
C                                                                       00000100
      DATA IFIRST/0/                                                    00000110
      INTEGER SQX, SQY, SL, DIMENY, DIMENX, COUNTY                      00000120
      DIMENSION F(DIMENY,DIMENX)                                        00000130
      COMMON /VECFO/AGER(5), STATE(5,10), CNTY(5,15),IDCO(15),          00000140
      XLTWO = LTWO                                                      00000290
      FMAX = 0.                                                         00000300
      DO 191 J=1,DIMENX                                                 00000310
      DO 191 I=1,DIMENY                                                 00000320
  191 IF(F(I,J).GT.FMAX)FMAX=F(I,J)                                     00000330
     1                 GRECO(15),SQX(1800),SQY(1800),SL(1800),POPULA(1800) 00000150
     2                ,HOUSIN(1800),FRAC(1800),COUNTY(1800)             00000160
      COMMON /LINFO/ NSTATE, NUMCO, NRECT, NX, NY, LTWO, GXMIN, GXMAX,  00000170
     1                 GYMIN, GYMAX, XORIG, YORIG, MTOZ, ID, YASSOC     00000180
      COMMON/IPARM/ UNITAR,ISHIFT,XMAXD,YMAXD,EPS,MAXSQR                00000190
      COMMON /IOFILE/ NR, NP, NPUNCH, NIN1, NIN2, NOUT1, NOUT2          00000200
      IF(IFIRST.NE.0)GO TO 1195                                         00000210
C                                                                       00000220
C  INITIALIZE.  FIND MAX F IN F(I,J).                                   00000230
C                                                                       00000240
      LTWO18 = 2**18                                                    00000250
      LTWO9 = 2**9                                                      00000260
      IUNIT = UNITAR                                                    00000270
      IFIRST = 1                                                        00000280
      WRITE(NP,31) FMAX                                                 00000340
   31 FORMAT(/' SUBROUTINE GRIDDIT.  FMAX =',E12.5)                     00000350
C                                                                       00000360
C  THE INITIAL SQUARES OF SIZE 2**L.                                    00000370
```

Reproduced from
best available copy.

```
C
 1195 DO 199 M=1,MAXSQR
      SQX(M)=0
      SQY(M)=0
      POPULA(M) = 0
      HOUSIN(M) = 0
  199 SL(M)=0
      M=0
      DO 194 I=1,NY
      IY = (I-1)*LTWO
      DO 194 J=1,NX
      JX=(J-1)*LTWO
      M=M+1
      SQX(M) = JX
      SQY(M) = IY
  194 SL(M) = LTWO
      NUMSQR=M
C      WRITE(NP,32) NUMSQR,(M,SQX(M),SQY(M),SL(M),M=1,NUMSQR)
   32 FORMAT(/' INITIAL SQUARES',I5,10(/5(5X4I5)))
      M=0
  195 M=M+1
C      PRINT 34 , M
   34 FORMAT(/' 195.  M =',I4)
      IF(M.GT.NUMSQR)GO TO 210
      IF(M.GT.MAXSQR)RETURN 1
C
C  INTEGRATE F(Y,X) OVER SQUARE NUMBER M:
  196 CALL INTEGR(M,F, DIMENY, DIMENX, XINT)
C
      IF(XINT.EQ.0.)CALL DELETE(&196,M,NUMSQR)
C
C        PRINT 35,M,XINT,POPULA(M),SQX(M),SQY(M),SL(M)
   35 FORMAT(/'  CALL INTEGR.   M, XINT =',I4,2E12.4,3I4)
C  IF SQUARE #M CONTAINS MORE THAN FMAX POPULATION, PARTITION IT;
C  IF NOT, GO TO NEXT SQUARE, M+1.
C
      IF(XINT.LE.FMAX)POPULA(M) = XINT
      IF(XINT.LE.FMAX) GO TO 195                                        00000750
C                                                                       00000760
C  STOP PARTITIONING CELL #M WHEN IT BECOMES SIZE UNITAR.               00000770
C                                                                       00000780
       IF(SL(M).EQ.IUNIT)GO TO 195                                      00000790
      CALL PARTIT(&210,&196,M,NUMSQR)                                   00000800
C                                                                       00000810
C  ADJUST CONTAINED POPULATION .                                        00000820
C                                                                       00000830
  210 IF(NUMSQR.GT.MAXSQR) RETURN 1                                     00000840
      WRITE(NP,33)M,NUMSQR                                              00000850
   33 FORMAT(/' 210.  M GREATER THAN NUMSQR.',2I5)                      00000860
      SUMF=0                                                            00000870
      DO 301 M=1,NUMSQR                                                 00000880
C      PRINT 38,M,POPULA(M),SUMF                                        00000890
   38 FORMAT(I4,2E12.4)                                                 00000900
  301   SUMF = SUMF + POPULA(M)                                         00000910
      A=SUMF                                                            00000920
      B = TOTPOP                                                        00000930
      CC=B/A                                                            00000940
C      PRINT 39, A,B,CC                                                 00000950
   39 FORMAT(/' A B C =',3E12.4)                                        00000960
      SUMF=0                                                            00000970
      DO 302 M=1,NUMSQR                                                 00000980
      POPULA(M)=POPULA(M)*CC                                            00000990
  302 SUMF = SUMF+POPULA(M)                                             00001000
       ERRPOP = TOTPOP-SUMF                                             00001010
      RETURN                                                            00001020
      ENTRY ADJUST(*,NUMSQR)                                            00001030
      WRITE(NP,1015) NUMSQR                                             00001040
 1015 FORMAT(/' SUBR. ADJUST.  NUMBER OF SQUARES =',I5)                 00001050
C                                                                       00001060
C  RTI.C44.P01303.JRP.ADJUST.FORT                                       00001070
C                                                                       00001080
C  ADJUST DELETES EMPTY SQUARES AND PARTITIONS SQUARES TRANSECTED BY    00001090
C  THE BOUNDARY.  SUCH SQUARES CONTAIN AT LEAST ONE EMPTY (ZERO         00001100
C                                                                       00001110
```

```
      I4 = 4.*UNITAR                                                    00001120
      M=0                                                               00001130
   10 M=M+1                                                             00001140
   11 IF(M.GT.NUMSQR)RETURN                                             00001150
      IF(POPULA(M).EQ.0.)CALL DELETE(&11,M,NUMSQR)                      00001160
C  DO NOT PARTITION SQUARES LESS THAN OR EQUAL TO I4 IN SIZE.           00001170
      IF(SL(M).LE.I4)GO TO 10                                           00001180
      ISL = SL(M)                                                       00001190
C                                                                       00001200
C  PARTITION SQUARES THAT ARE TOO LARGE:                                00001210
      IF(ISL.GE.32)CALL PARTIT(&5,&12,M,NUMSQR)                         00001220
      AREASQ = ISL*ISL                                                  00001230
      IG = SQY(M) + 1                                                   00001240
      IK = IG + ISL - 1                                                 00001250
      JG = SQX(M) + 1                                                   00001260
      JK = JG + ISL - 1                                                 00001270
      TAREA = 0.                                                        00001280
C                                                                       00001290
C  COMPUTE NUMBER UNIT AREA CELLS INSIDE SQUARE AND INSIDE COUNTY       00001300
C  BOUNDARY.                                                            00001310
      DO 20 I=IG,IK                                                     00001320
      DO 20 J=JG,JK                                                     00001330
   20 IF(F(I,J).GE.0.)TAREA = TAREA+UNITAR                              00001340
       IF(ABS(TAREA)/AREASQ.GE.0.50)GO TO 10                            00001350
C                                                                       00001360
C  PARTITION SQUARE WHICH HAS LESS THAN 50% AREA INTERIOR TO COUNTY.    00001370
C                                                                       00001380
      CALL PARTIT(&5,&12,M,NUMSQR)                                      00001390
C                                                                       00001400
C  UPDATE NEW CELLS RESULTING FROM PARTITIONING DUE TO TRANSECT:        00001410
   12 CALL INTEGR(M,F,DIMENY,DIMENX,XINT)                               00001420
      POPULA(M) = XINT                                                  00001430
      L3=NUMSQR-2                                                       00001440
      DO 13 L=L3,NUMSQR                                                 00001450
      CALL INTEGR(L,F,DIMENY,DIMENX,XINT)                               00001460
   13 POPULA(L) = XINT                                                  00001470
      GO TO 11                                                          00001480
```

```
C  ERROR RETURN 45 IF MAX NUMBER PERMISSIBLE SQUARES EXCEEDED.
    5 WRITE(NP,1015) NUMSQR
      RETURN 1
      ENTRY SQROFF(*,NUMSQR)
C
C  COMPUTE SEPARATE INTEGRALS OF POPULATION, HOUSING, AND AREA OVER EACH
C  GRID SQUARE FOR EACH COUNTY THE GRID SQUARE OVERLAYS.
C
C
      DO 1 M=1,MAXSQR
      POPULA(M)=0
      HOUSIN(M)=0
      FRAC(M)=0
    1 COUNTY(M)=0
C
C  PROCESS EACH COUNTY
C
      NRSQR = NUMSQR
      DO 9 L=1,NUMCO
C
C  PROCESS FOR EACH OF THE 3 INTEGRALS, POPULATION, HOUSING, AREA:
C
C  POPULATION AND HOUSING ARE ON NOUT1.
C  AREA IS ON NOUT2.
      DO 9 KK=1,3
      DO 8 J=1,DIMENX
      DO 8 I=1,DIMENY
    8 F(I,J)=0.
      IF(KK.NE.3)NOUT=NOUT1
      IF(KK.EQ.3)NOUT=NOUT2
      IF(KK.NE.2)READ(NOUT)LL,ID,IGO,IKWIT,JGO,JKWIT
      DO 2 I=IGO,IKWIT
    2 READ(NOUT)(F(I,J),J=JGO,JKWIT)
      IF(KK.NE.3)GO TO 4
      DO 3 IK=2,3
      DO 3 II=IGO,IKWIT
    3 READ(NOUT2) DUMM
```

Reproduced from best available copy.

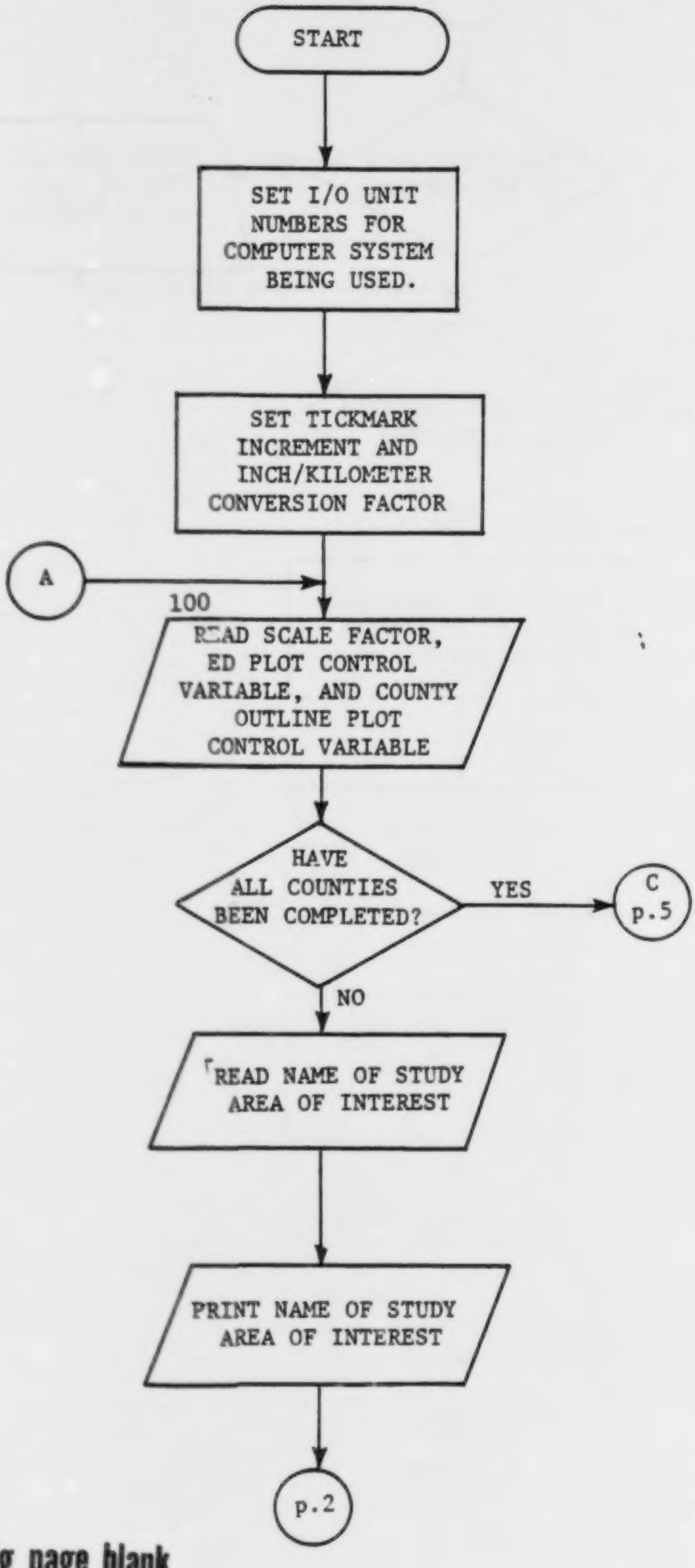
```
C
C  PROCESS THE GRID SQUARES, M=1,2,...,NUMSQR.
    4 IF(KK.EQ.1) KSQR = NUMSQR
      IF(KK.GT.1) KSQR = NRSQR
      DO 9 MPRIME = 1,KSQR
      M = MPRIME
C
C
C  DOES SQUARE M SHARE ANY COMMON AREA WITH RECTANGLE THAT CONTAINS THIS
C  COUNTY?
C
      IF(SQY(M).GT.IKWIT)GO TO 9
      IF(SQX(M).GT.JKWIT)GO TO 9
      IF(SQY(M)+SL(M).LT.IGO)GO TO 9
      IF(SQX(M)+SL(M).LT.JGO)GO TO 9
C  DOES SQUARE M SHARE ANY COMMON AREA WITH THIS COUNTY?
      CALL INTEGR(M,F,DIMENY,DIMENX,XINT)
      IF(XINT.LE.0.)GO TO 9
C
C  THE INTEGRAL GREATER THAN ZERO MEANS SOME OF THIS COUNTY IS IN SQUARE
C  NUMBER M.
C  IS THIS THE FIRST COUNTY TO HAVE CONTENTS IN SQUARE M?
C
      IF(KK.EQ.1.AND.POPULA(M).EQ.0.)GO TO 6
      IF(KK.EQ.2.AND.HOUSIN(M).GT.0.)GO TO 9
      IF(KK.EQ.3.AND.FRAC(M).GT.0.)GO TO 9
      IF(KK.GT.1)GO TO 7
C
C  NON-ZERO VALUE OF POPULA OR HOUSIN OR FRAC FOR SQUARE M MEANS THAT
C  SQUARE M HAS OCCURRED FOR A PRIOR COUNTY.  THIS IS A NEW COUNTY FOR M
C
C  PROCESS SQUARE #MPRIME FOR A DIFFERENT COUNTY.  WILL RESULT IN AN
C  ADDITIONAL RECORD FOR SQUARE #MPRIME.
C
      NRSQR = NRSQR + 1
C
C  THE MAXIMUM NUMBER OF SQUARES IS LIMITED BY DIMENSIONS TO 'MAXSQR'.
```

```
      IF(NRSQR.GT.MAXSQR) RETURN 1                                      00002260
      M=NRSQR                                                           00002270
C                                                                       00002280
C  INITIALIZE DUPLICATE RECORD FOR SQUARE #M.                           00002290
C                                                                       00002300
      SQX(M) = SQX(MPRIME)                                              00002310
      SQY(M) = SQY(MPRIME)                                              00002320
      SL(M) = SL(MPRIME)                                                00002330
    6 COUNTY(M) = L*ITWO18 + SQY(M)*ITWO9 + SQX(M)                      00002340
      POPULA(M)=XINT                                                    00002350
    7 IF(KK.EQ.2)HOUSIN(M)=XINT                                         00002360
      IF(KK.EQ.3)FRAC(M)=XINT/SL(M)**2                                  00002370
C      PRINT 1606,L,KK,MPRIME,M,NRSQR,NUMSQR,SQX(M),SQY(M),SL(M),       00002380
C     1 XINT,HOUSIN(M),POPULA(M),FRAC(M)                                00002390
 1606 FORMAT(9I4,4E12.4)                                                00002400
    9 CONTINUE                                                          00002410
      NUMSQR = NRSQR                                                    00002420
      RETURN                                                            00002430
C                                                                       00001540
C                                                                       00002440
      ENTRY OUTPUT                                                      00002450
C                                                                       00002460
C  WRITE RECORD FOR EACH GRID SQUARE:                                   00002470
C                                                                       00002480
      XEND = XORIG + DX*LTWO                                            00002490
      YEND = YORIG + DY*LTWO                                            00002500
      WRITE(NPUNCH,105) XORIG,YORIG,XEND,YEND,MTOZ                      00002510
C        WRITE(NP,105) XORIG,YORIG,XEND,YEND,MTOZ                       00002520
  105 FORMAT(4F5.0,I5)                                                  00002530
  104 FORMAT(I5,I6,I3,I5,I3,2F10.5,I3,2E13.5)                           00002540
      DO 29 KK=1,2                                                      00002550
      IF(KK.EQ.1) INP=NP                                                00002560
      IF(KK.EQ.2) INP = NPUNCH                                          00002570
        MM=0                                                            00002580
      DO 29 M=1,NUMSQR                                                  00002590
      IF(POPULA(M).EQ.0.)GO TO 29                                       00002600
      MM = MM+1                                                         00002610
      L = COUNTY(M)/ITWO18                                              00002620
      ISTATE = IDCO(L)/1000                                             00002630
      ICOUNT = IDCO(L) - ISTATE*1000                                    00002640
      IFRAC = FRAC(M)*1.E5                                              00002650
      YY = SQY(M)+YORIG                                                 00002660
      XX = SQX(M)+XORIG                                                 00002670
      WRITE(INP,104)MM,IFRAC,ISTATE,ICOUNT,MTUZ,XX,YY,SL(M),            00002680
     1 HOUSIN(M),POPULA(M)                                              00002690
   29 CONTINUE                                                          00002800
      RETURN                                                            00002810
      END                                                               00003000
```

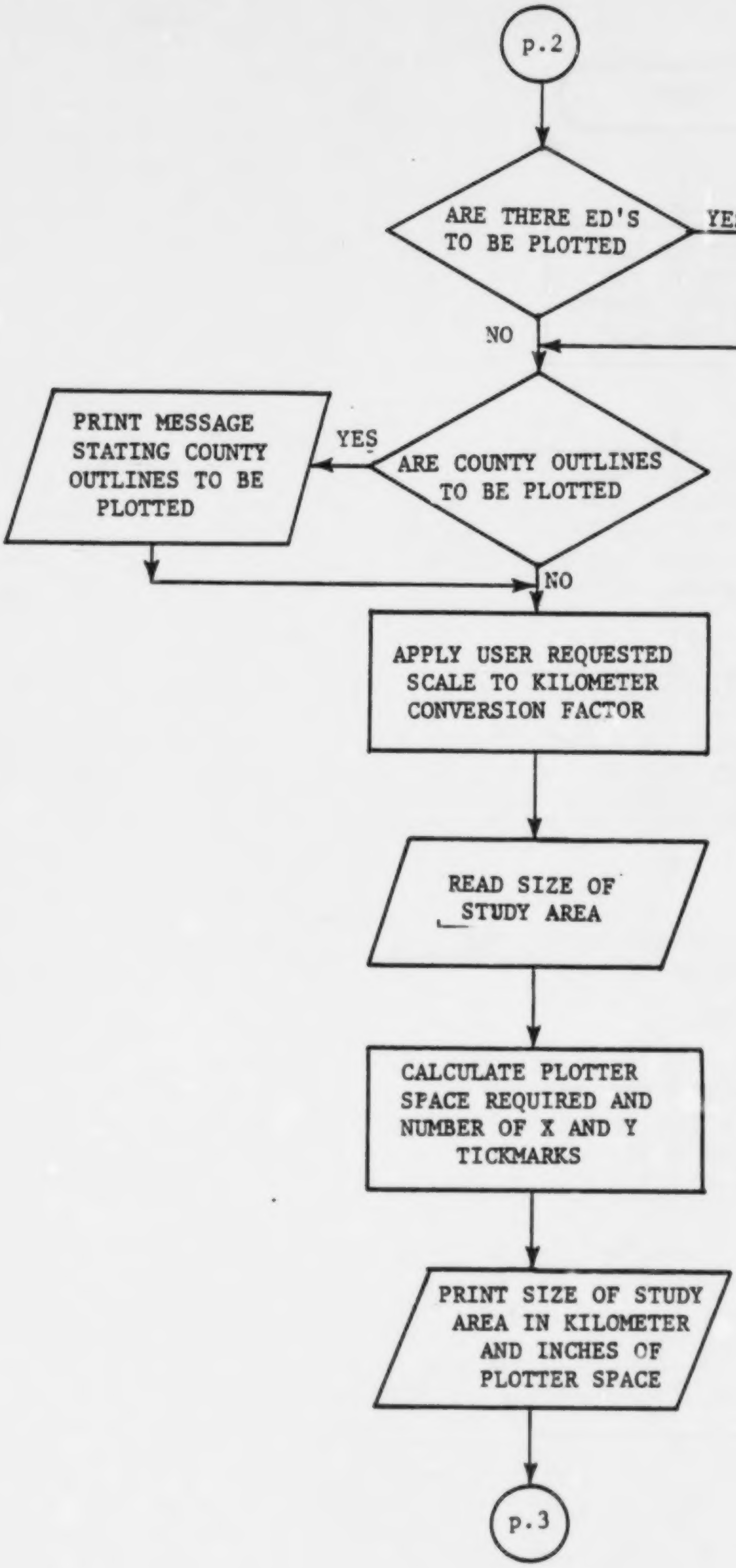
```
C
C  COLLECTION OF AUXILIARY SUBROUTINES USED IN GRIDDING.
C
      SUBROUTINE INTEGR(M,F, DIMENY, DIMENX, XINT)
      INTEGER SQX,SQY,SL, DIMENY, DIMENX, COUNTY
      DIMENSION F(DIMENY, DIMENX)
      COMMON/VECFU/ AQCR(5), STATE(5,10),CNTY(5,15),IDCU(15),
     1              NRECO(15),SQX(1800),SQY(1800),SL(1800),
     2              POPULA(1800), HOUSIN(1800), FRAC(1800), COUNTY(1800)
      COMMON /IPARM/ UNITAR,ISHIFT,XMAXD,YMAXD,EPS,MAXSQR
C
C  COMPUTE INTEGRAL (XINT) OF ARRAY F(Y,X)=F(I,J) OVER SQUARE #M.
C
      ISLM = SL(M)
      IG=SQY(M)+1
      IK=IG + ISLM - 1
      JG = SQX(M)+1
      JK = JG + ISLM - 1
      XINT = 0.
      DO 1 I=IG,IK
      DO 1 J=JG,JK
    1 XINT = XINT + F(I,J)
      RETURN
      ENTRY DELETE(*,M,NUMSQR)
C
C  COMPRESS THE LIST OF SQUARES AS RESULT OF DELETING SQUARE #M
      NUMSQR=NUMSQR-1
      DO 401 L=M,NUMSQR
      LP1 = L+1
      SQX(L)=SQX(LP1)
      SQY(L)=SQY(LP1)
      SL(L)=SL(LP1)
      FRAC(L) = FRAC(LP1)
      COUNTY(L) = COUNTY(LP1)
      HOUSIN(L) = HOUSIN(LP1)
  401 POPULA(L) = POPULA(LP1)
      RETURN 1
      ENTRY PARTIT(*,*,M,NUMSQR)
C
C  THE FIRST RETURN * IS ERROR RETURN IN CASE NUMBER OF SQUARES EXCEEDS
C  THE MAXIMUM BECAUSE OF PARTITIONING.
C  THE SECOND RETURN * IS NORMAL RETURN TO CALLING PROGRAM.
      ISLM = SL(M)/2
      SLM = ISLM
      IF(SLM.LT.UNITAR)RETURN 2
      L=NUMSQR
      LP1 = L+1
      LP2 = L+2
      LP3 = L+3
      IF(LP3.GT.MAXSQR)RETURN 1
      SL(M)=ISLM
      SL(LP1)=ISLM
      SL(LP2)=ISLM
      SL(LP3)=ISLM
      SQX(LP1)=SQX(M) + ISLM
      SQY(LP1)=SQY(M)
      SQX(LP2)=SQX(LP1)
      SQY(LP2)=SQY(M) + ISLM
      SQY(LP3) = SQY(LP2)
      SQX(LP3)=SQX(M)
      NUMSQR = NUMSQR+3
      RETURN 2
      END
      SUBROUTINE ASTORE(*,A,B,C,D,E,F,G,H)                              00001080
C   'ASTORE' IS CALLED BY SUBROUTINE WRAPUP TO SET SPECIFIED EQUALITIES 00001090
C   AND BRANCH TO THE STATEMENT NUMBER '*' IN WRAP-UP.                  00001100
C                                                                       00001110
      A=B                                                               00001120
      C=D                                                               00001130
      E=F                                                               00001140
      G=H                                                               00001150
      RETURN 1                                                          00001160
      ENTRY NSTORE(*,I,J,K,L)                                           00001170
C   'NSTORE' IS CALLED BY SUBR. DECIDE AND SIDEIT TO SET SPECIFIC       00001180
C   EQUALITIES AND RETURN TO STATEMENT NUMBER '*' IN CALLING PROGRAM.   00001190
      I=J                                                               00001200
      K=L                                                               00001210
      RETURN 1                                                          00001220
      ENTRY YOFX(X,X1,Y1,X2,Y2,Y)                                       00001230
C                                                                       00001240
C   SUBROUTINES YOFX AND XOFY SOLVE FOR Y AND X IN TERMS OF X AND Y.    00001250
C   CALLED BY SUBROUTINE SIDEIT TO FIND INTERSECTIONS OF SEGMENT AND CELL00001260
C   SIDES.                                                              00001270
C                                                                       00001280
       COMMON/IPARM/UNITAR,ISHIFT,XMAXD,YMAXD,EPS,MAXSQR                00001290
      Y=2.*YMAXD                                                        00001300
      IF(ABS(X2-X1).LT.EPS)RETURN                                       00001310
      Y = (Y2-Y1)/(X2-X1)*(X-X1) + Y1                                   00001320
      RETURN                                                            00001330
      ENTRY XOFY([illegible]X1,Y1,X2,Y2,X)                              00001340
      X=2.*XMAXD                                                        00001350
      IF(ABS(Y2-Y1).LT.EPS)RETURN                                       00001360
      X = (X2-X1)/(Y2-Y1)*(Y-Y1) + X1                                   00001370
      RETURN                                                            00001380
      END                                                               00001390
      FUNCTION FAREA(X1,Y1,X2,Y2)
C
C  'FAREA' COMPUTES THE AREA UNDER THE SEGMENT DIRECTED FROM NODE
C  (X1,Y1) TO NODE(X2,Y2).
      FAREA=(X2-X1)*(Y1+Y2)/2.
      RETURN
      END
      SUBROUTINE SORT(NUMSQR)
C
C  SUBROUTINE SORT SORTS THE LIST OF GRID SQUARES INTO ASCENDING
C  ORDER OF THE ARRAY OF COMPOSITE NUMBERS, COUNTY(M), M=1,2,...,
C  NUMSQR.  COUNTY(M)=L(M)*2**18 + SQY(M)*2**9 + SQX(M) AND IS
C  COMPUTED IN SUBROUTINE SQROFF.
C
      INTEGER COUNTY(1800)
      COMMON/VECFO/ DUMMY(160), LIST(1800,7)
      EQUIVALENCE (COUNTY(1),LIST(10801))
      DO 20 I=2,NUMSQR
      K=I-1
      DO 10 J=I,NUMSQR
   10 IF(COUNTY(J).LT.COUNTY(K))K=J
C
C  RE-ORDER THE OTHER VARIABLES ASSOCIATED WITH SQUARES K AND I-1.
C
      DO 20 M=1,7
      ISAVE = LIST(I-1,M)
      LIST(I-1,M) = LIST(K,M)
   20 LIST(K,M) =ISAVE
      RETURN
      END
```

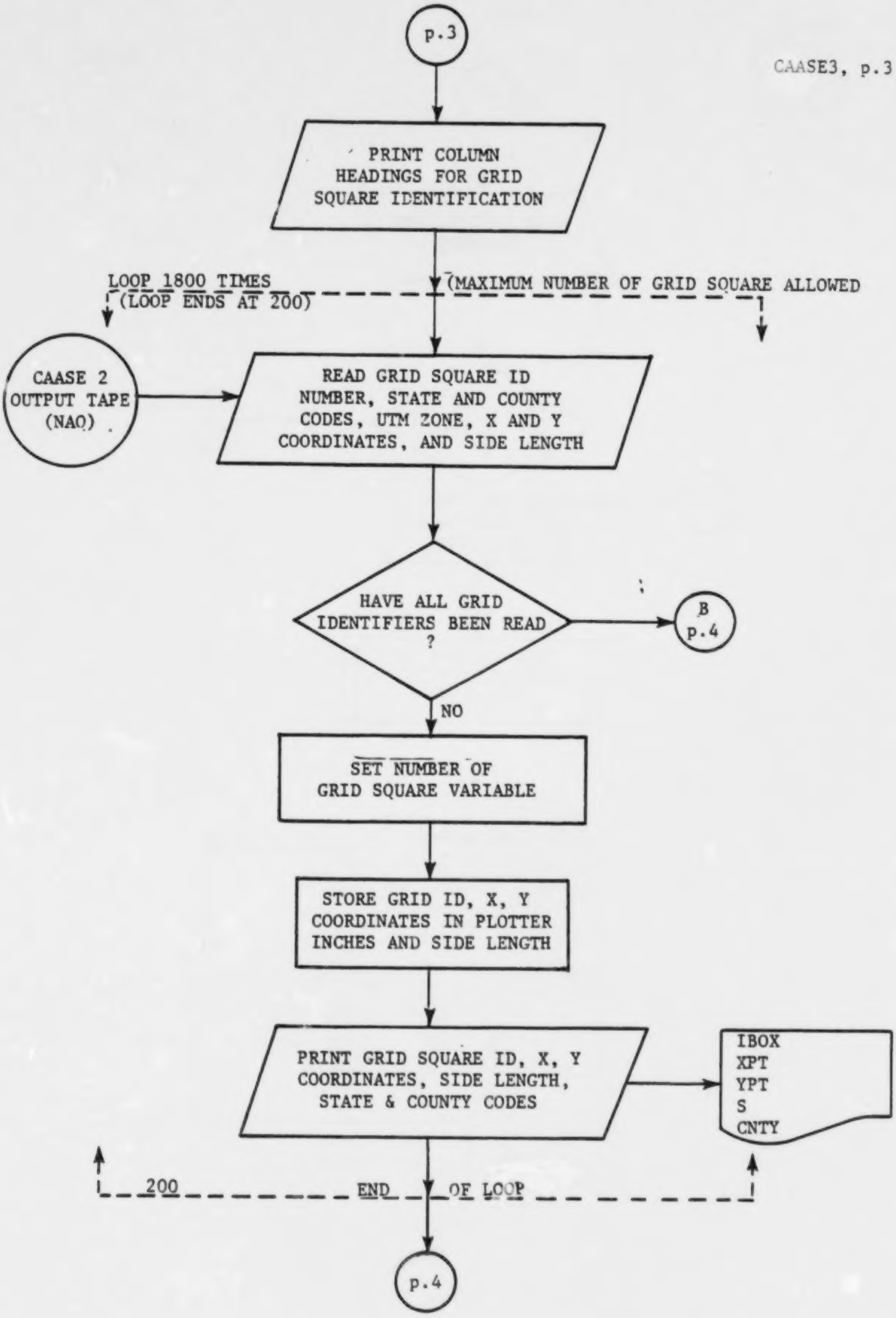
APPENDIX C

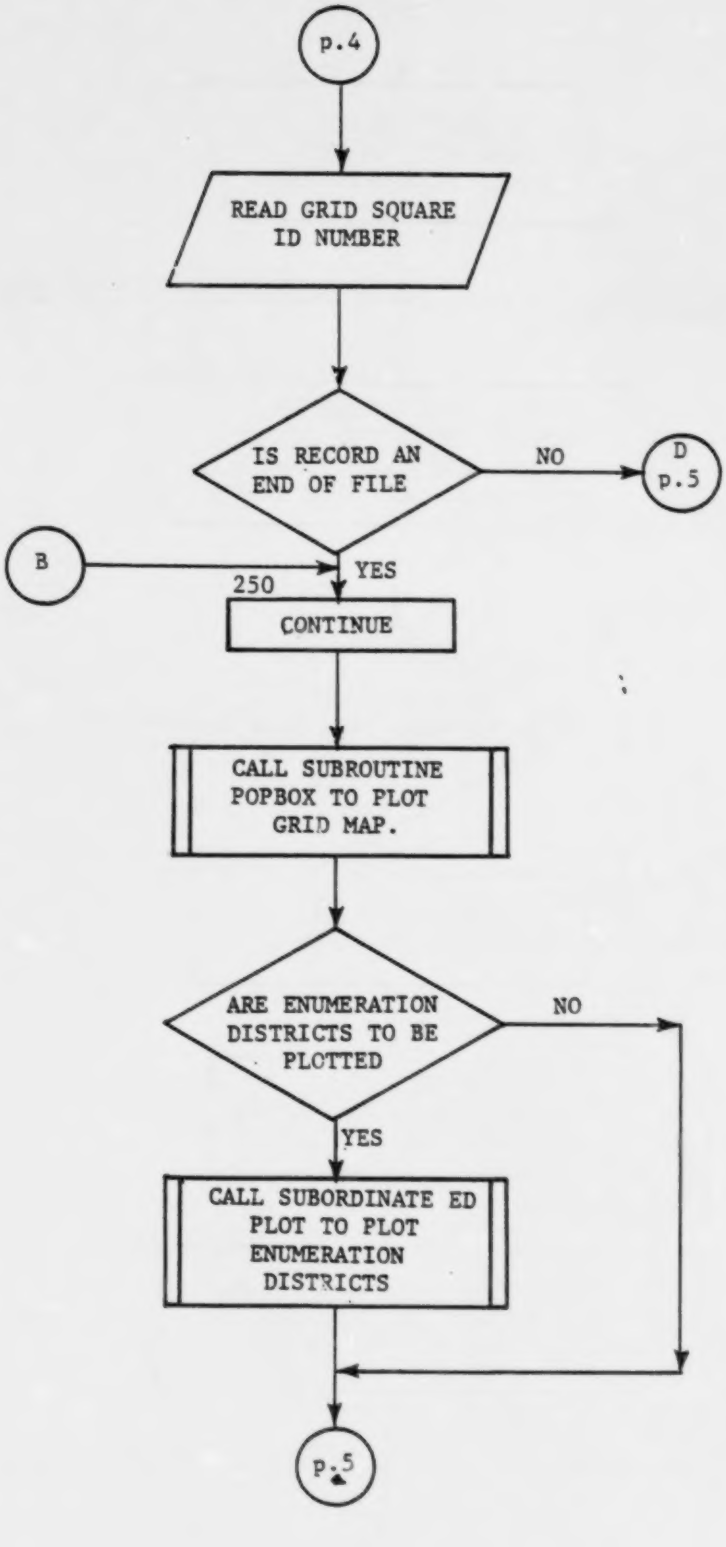
LOGICAL FLOWCHARTS AND FORTRAN SOURCE CODE LISTINGS
CAASE3 (and Subroutines)

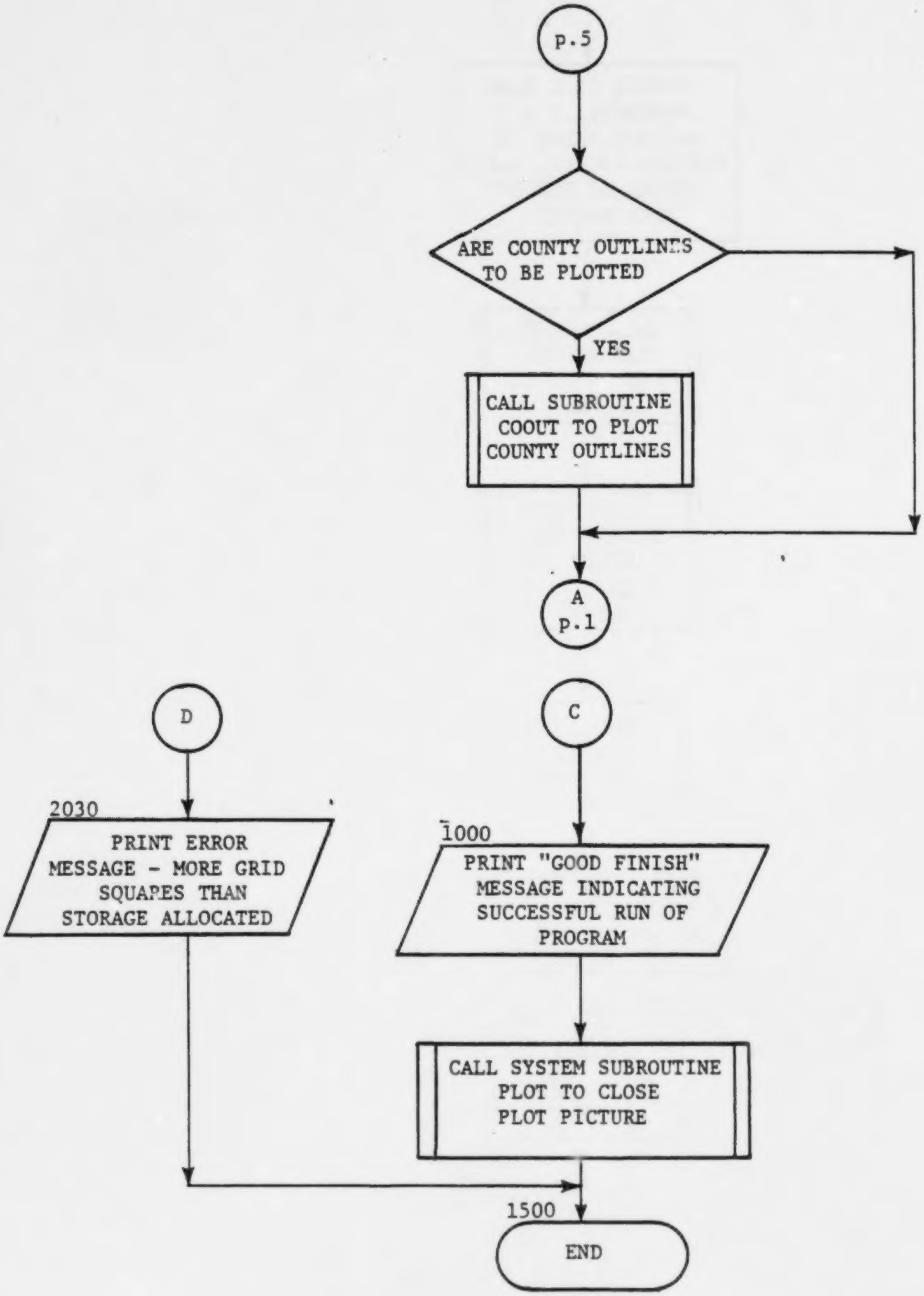

START
SET I/O UNIT NUMBERS FOR COMPUTER SYSTEM BEING USED.
SET TICKMARK INCREMENT AND INCH/KILOMETER CONVERSION FACTOR
A
100
READ SCALE FACTOR, ED PLOT CONTROL VARIABLE, AND COUNTY OUTLINE PLOT CONTROL VARIABLE
HAVE ALL COUNTIES BEEN COMPLETED?
YES
C p.5
NO
READ NAME OF STUDY AREA OF INTEREST
PRINT NAME OF STUDY AREA OF INTEREST
p.2

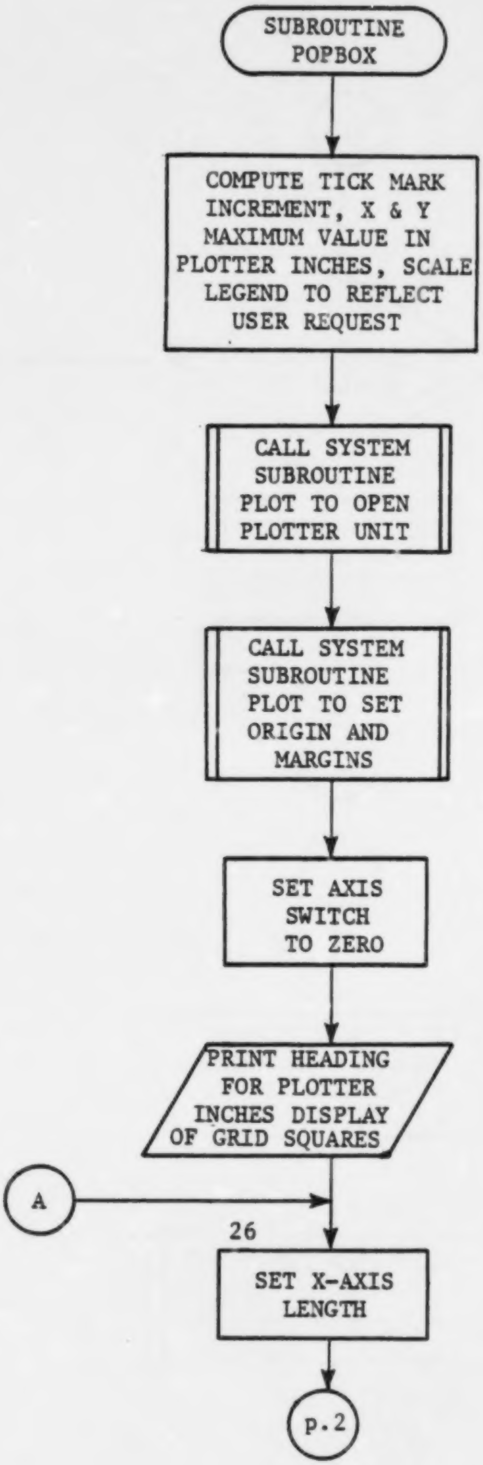
Preceding page blank


p.2
ARE THERE ED'S TO BE PLOTTED
YES
PRINT MESSAGE STATING ED'S TO BE PLOTTED
NO
ARE COUNTY OUTLINES TO BE PLOTTED
YES
PRINT MESSAGE STATING COUNTY OUTLINES TO BE PLOTTED
NO
APPLY USER REQUESTED SCALE TO KILOMETER CONVERSION FACTOR
READ SIZE OF STUDY AREA
CALCULATE PLOTTER SPACE REQUIRED AND NUMBER OF X AND Y TICKMARKS
PRINT SIZE OF STUDY AREA IN KILOMETER AND INCHES OF PLOTTER SPACE
p.3

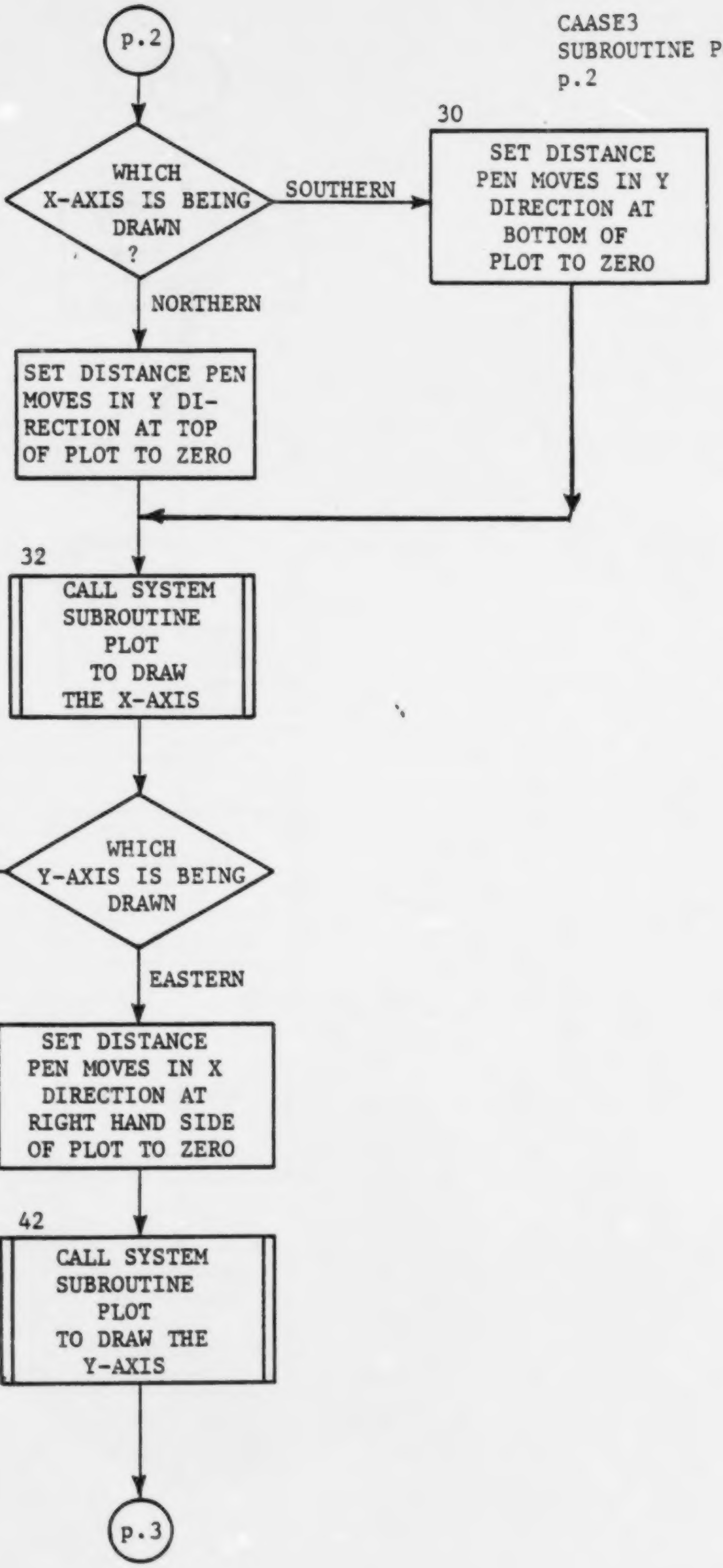

p.3
PRINT COLUMN HEADINGS FOR GRID SQUARE IDENTIFICATION
LOOP 1800 TIMES
(LOOP ENDS AT 200)
(MAXIMUM NUMBER OF GRID SQUARE ALLOWED
CAASE 2 OUTPUT TAPE (NAO)
READ GRID SQUARE ID NUMBER, STATE AND COUNTY CODES, UTM ZONE, X AND Y COORDINATES, AND SIDE LENGTH
HAVE ALL GRID IDENTIFIERS BEEN READ ?
B p.4
NO
SET NUMBER OF GRID SQUARE VARIABLE
STORE GRID ID, X, Y COORDINATES IN PLOTTER INCHES AND SIDE LENGTH
PRINT GRID SQUARE ID, X, Y COORDINATES, SIDE LENGTH, STATE & COUNTY CODES
IBOX
XPT
YPT
S
CNTY
200
END OF LOOP
p.4

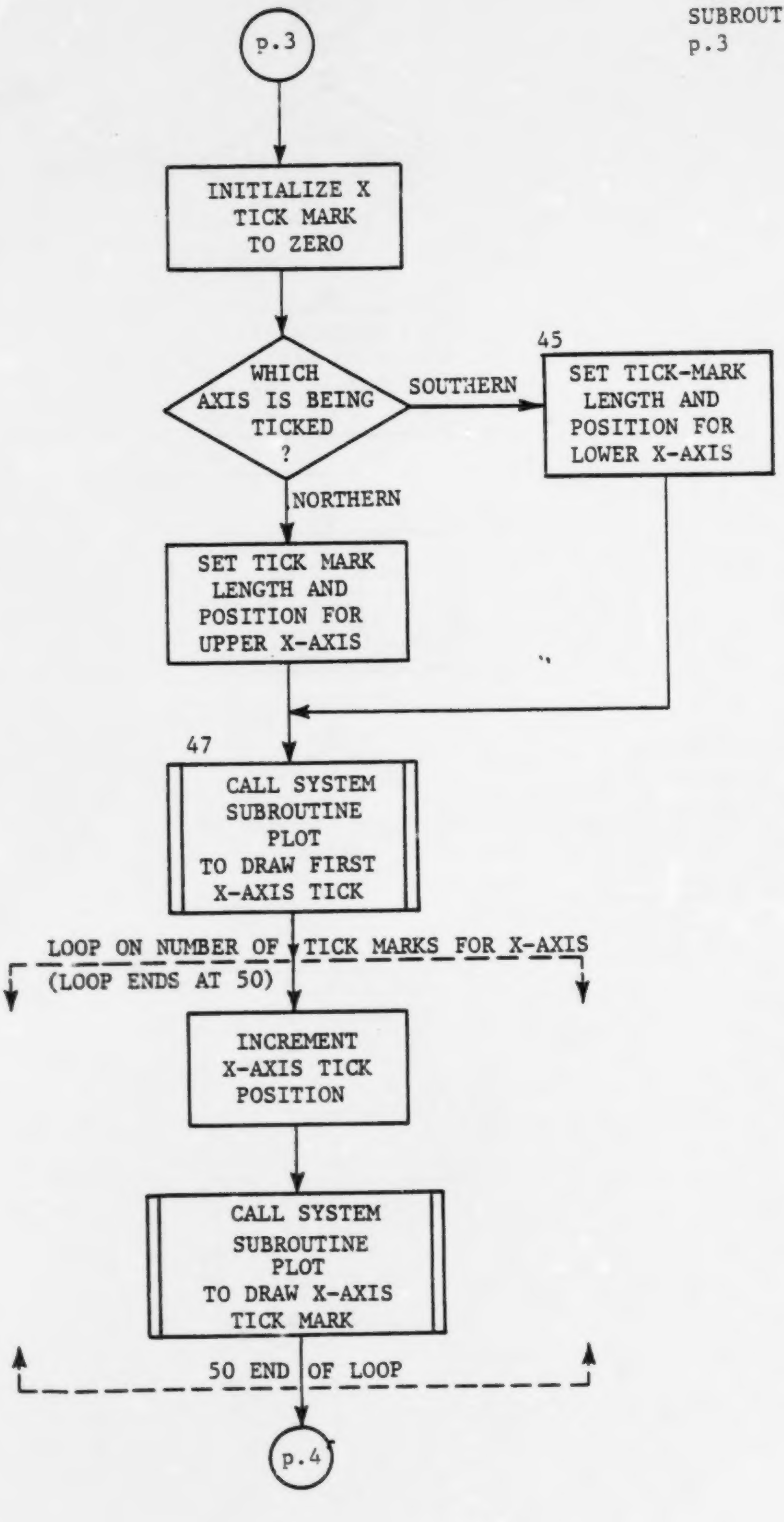

p.4
READ GRID SQUARE ID NUMBER
IS RECORD AN END OF FILE
NO
D
p.5
B
YES
250
CONTINUE
CALL SUBROUTINE POPBOX TO PLOT GRID MAP.
ARE ENUMERATION DISTRICTS TO BE PLOTTED
NO
YES
CALL SUBORDINATE ED PLOT TO PLOT ENUMERATION DISTRICTS
p.5

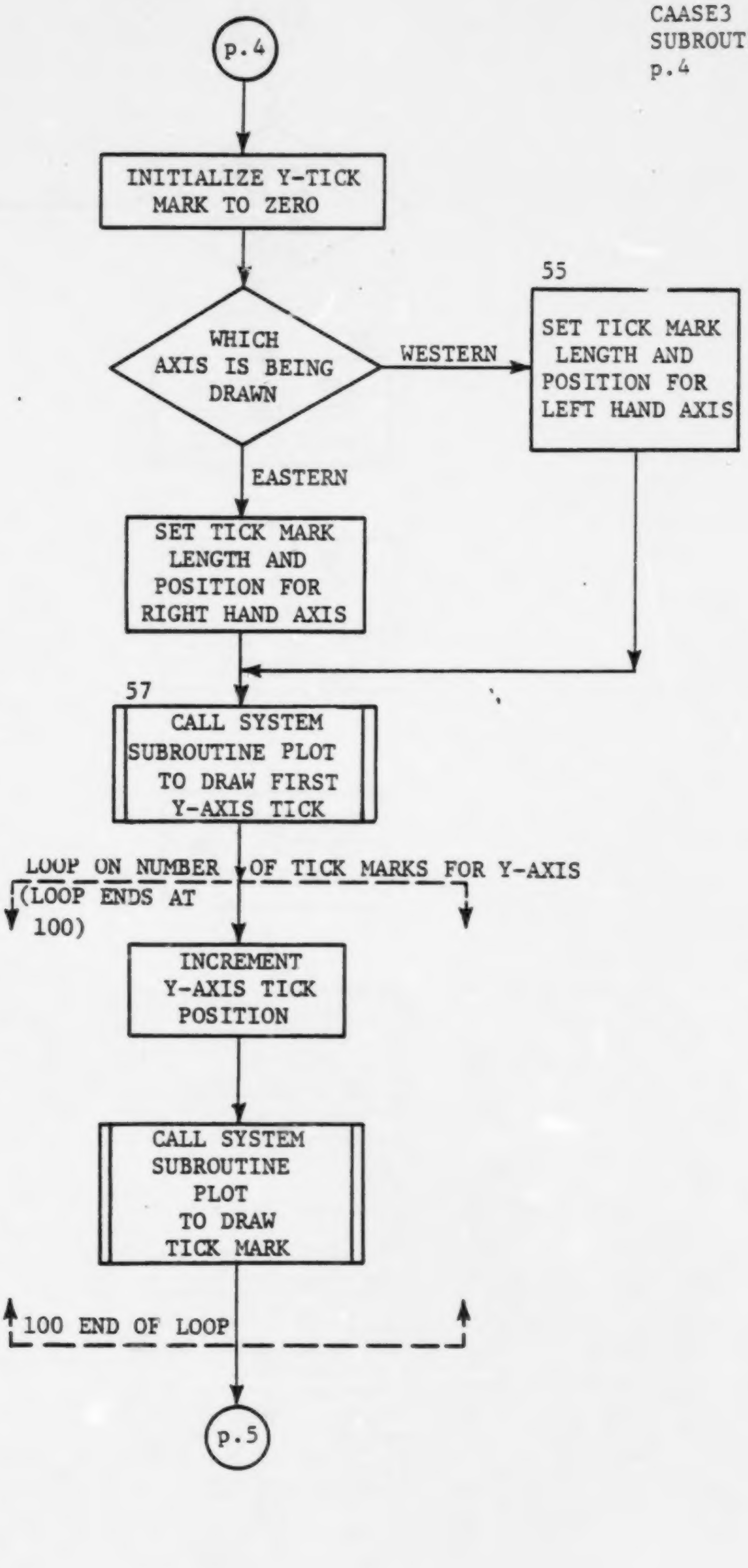

p.5
ARE COUNTY OUTLINES TO BE PLOTTED
YES
CALL SUBROUTINE COOUT TO PLOT COUNTY OUTLINES
A p.1
D
C
2030
PRINT ERROR MESSAGE - MORE GRID SQUARES THAN STORAGE ALLOCATED
1000
PRINT "GOOD FINISH" MESSAGE INDICATING SUCCESSFUL RUN OF PROGRAM
CALL SYSTEM SUBROUTINE PLOT TO CLOSE PLOT PICTURE
1500
END

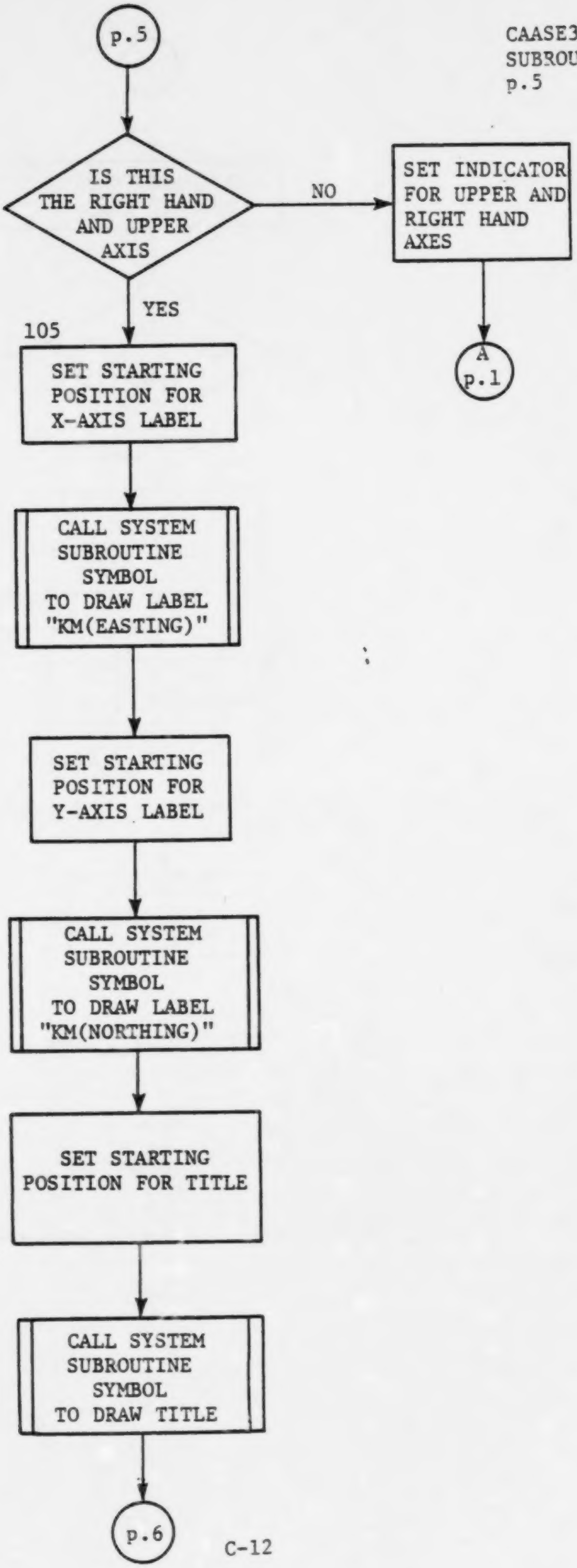

SUBROUTINE POPBOX
COMPUTE TICK MARK INCREMENT, X & Y MAXIMUM VALUE IN PLOTTER INCHES, SCALE LEGEND TO REFLECT USER REQUEST
CALL SYSTEM SUBROUTINE PLOT TO OPEN PLOTTER UNIT
CALL SYSTEM SUBROUTINE PLOT TO SET ORIGIN AND MARGINS
SET AXIS SWITCH TO ZERO
PRINT HEADING FOR PLOTTER INCHES DISPLAY OF GRID SQUARES
A
26
SET X-AXIS LENGTH
p.2

CAASE3
SUBROUTINE POPBOX
p.2

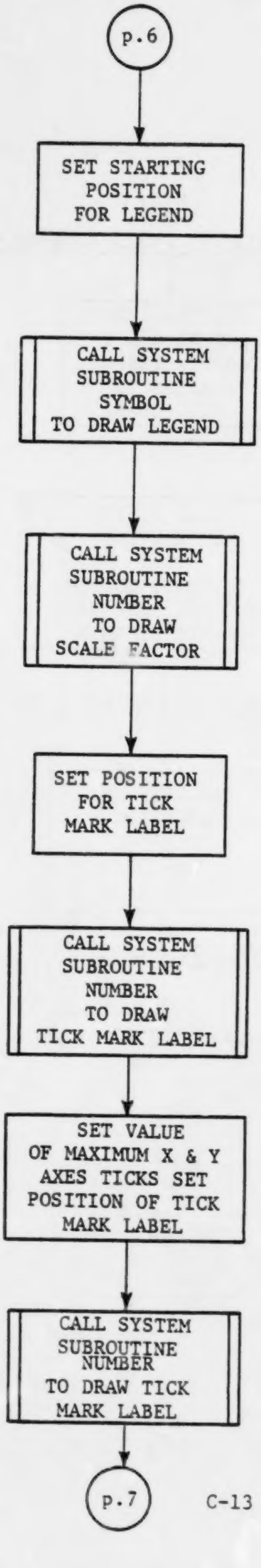

p.2
WHICH X-AXIS IS BEING DRAWN ?
SOUTHERN
30
SET DISTANCE PEN MOVES IN Y DIRECTION AT BOTTOM OF PLOT TO ZERO
NORTHERN
SET DISTANCE PEN MOVES IN Y DIRECTION AT TOP OF PLOT TO ZERO
32
CALL SYSTEM SUBROUTINE PLOT TO DRAW THE X-AXIS
40
SET DISTANCE PEN MOVES IN X DIRECTION AT LEFT HAND SIDE OF PLOT TO ZERO
WESTERN
WHICH Y-AXIS IS BEING DRAWN
EASTERN
SET DISTANCE PEN MOVES IN X DIRECTION AT RIGHT HAND SIDE OF PLOT TO ZERO
42
CALL SYSTEM SUBROUTINE PLOT TO DRAW THE Y-AXIS
p.3

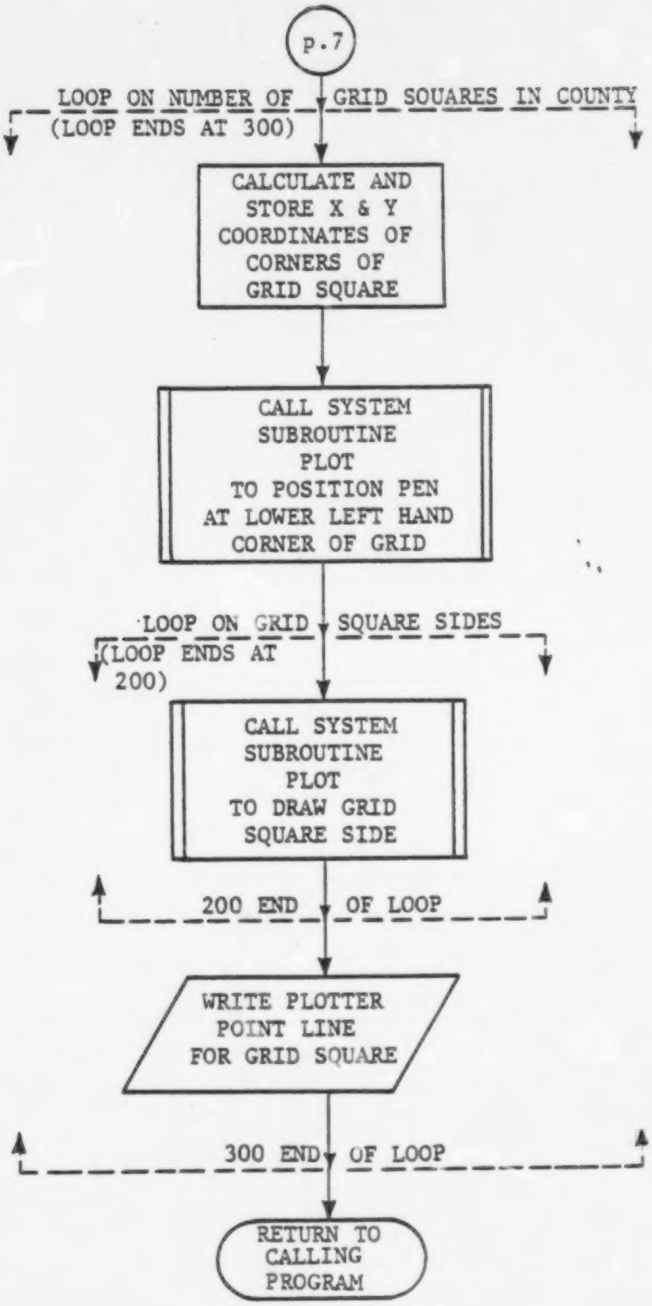

p.3
INITIALIZE X TICK MARK TO ZERO
WHICH AXIS IS BEING TICKED ?
SOUTHERN
45
SET TICK-MARK LENGTH AND POSITION FOR LOWER X-AXIS
NORTHERN
SET TICK MARK LENGTH AND POSITION FOR UPPER X-AXIS
47
CALL SYSTEM SUBROUTINE PLOT TO DRAW FIRST X-AXIS TICK
LOOP ON NUMBER OF TICK MARKS FOR X-AXIS
(LOOP ENDS AT 50)
INCREMENT X-AXIS TICK POSITION
CALL SYSTEM SUBROUTINE PLOT TO DRAW X-AXIS TICK MARK
50 END OF LOOP
p.4

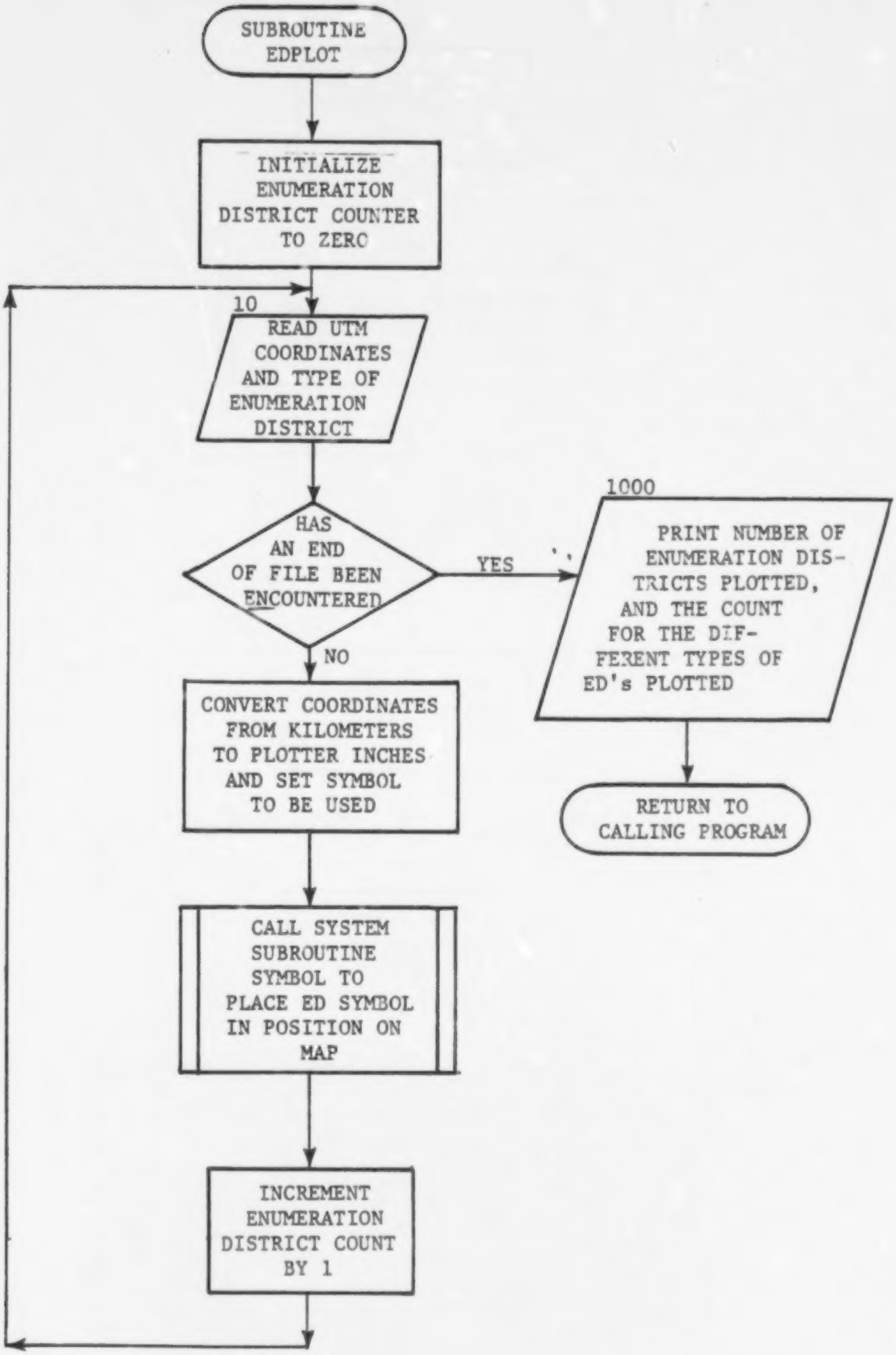

p.4
INITIALIZE Y-TICK MARK TO ZERO
WHICH AXIS IS BEING DRAWN
WESTERN
55
SET TICK MARK LENGTH AND POSITION FOR LEFT HAND AXIS
EASTERN
SET TICK MARK LENGTH AND POSITION FOR RIGHT HAND AXIS
57
CALL SYSTEM SUBROUTINE PLOT TO DRAW FIRST Y-AXIS TICK
LOOP ON NUMBER OF TICK MARKS FOR Y-AXIS
(LOOP ENDS AT 100)
INCREMENT Y-AXIS TICK POSITION
CALL SYSTEM SUBROUTINE PLOT TO DRAW TICK MARK
100 END OF LOOP
p.5

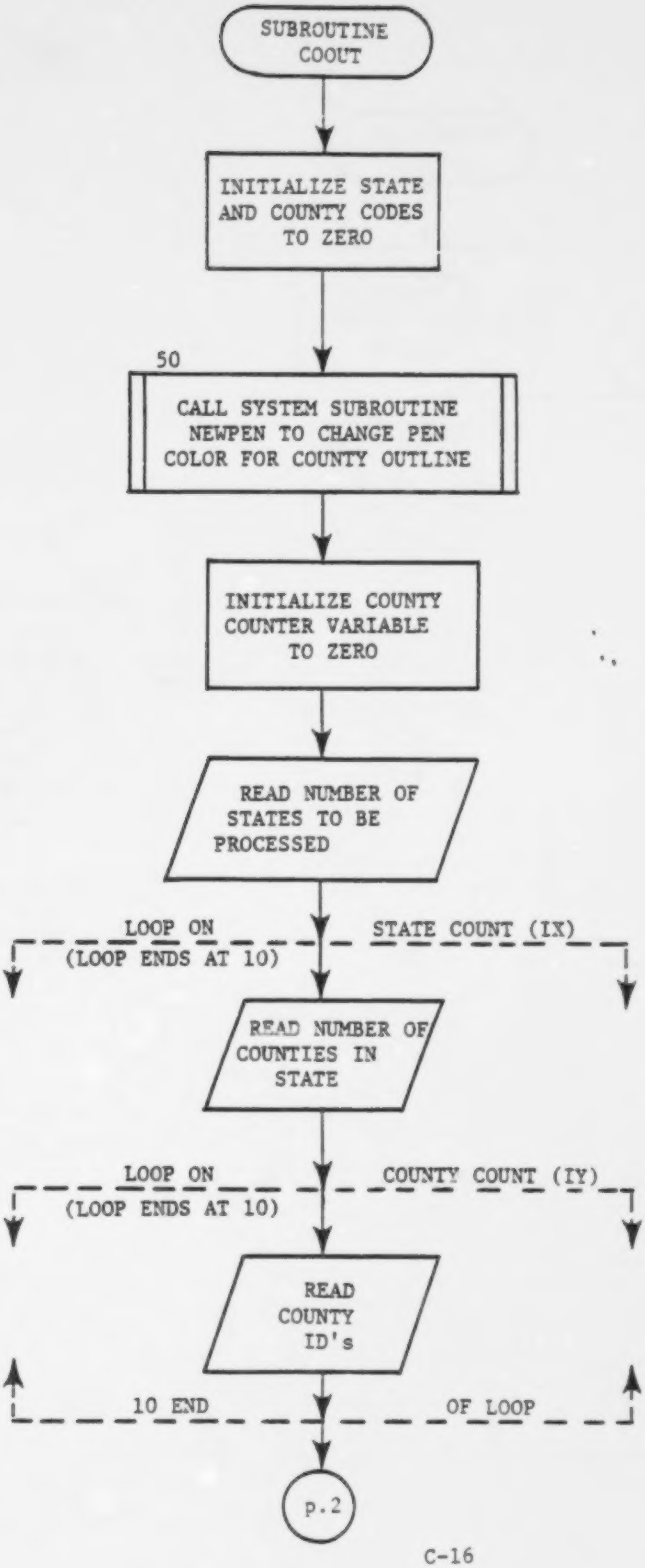

p.5
IS THIS THE RIGHT HAND AND UPPER AXIS
NO
SET INDICATOR FOR UPPER AND RIGHT HAND AXES
A p.1
YES
105
SET STARTING POSITION FOR X-AXIS LABEL
CALL SYSTEM SUBROUTINE SYMBOL TO DRAW LABEL "KM(EASTING)"
SET STARTING POSITION FOR Y-AXIS LABEL
CALL SYSTEM SUBROUTINE SYMBOL TO DRAW LABEL "KM(NORTHING)"
SET STARTING POSITION FOR TITLE
CALL SYSTEM SUBROUTINE SYMBOL TO DRAW TITLE
p.6

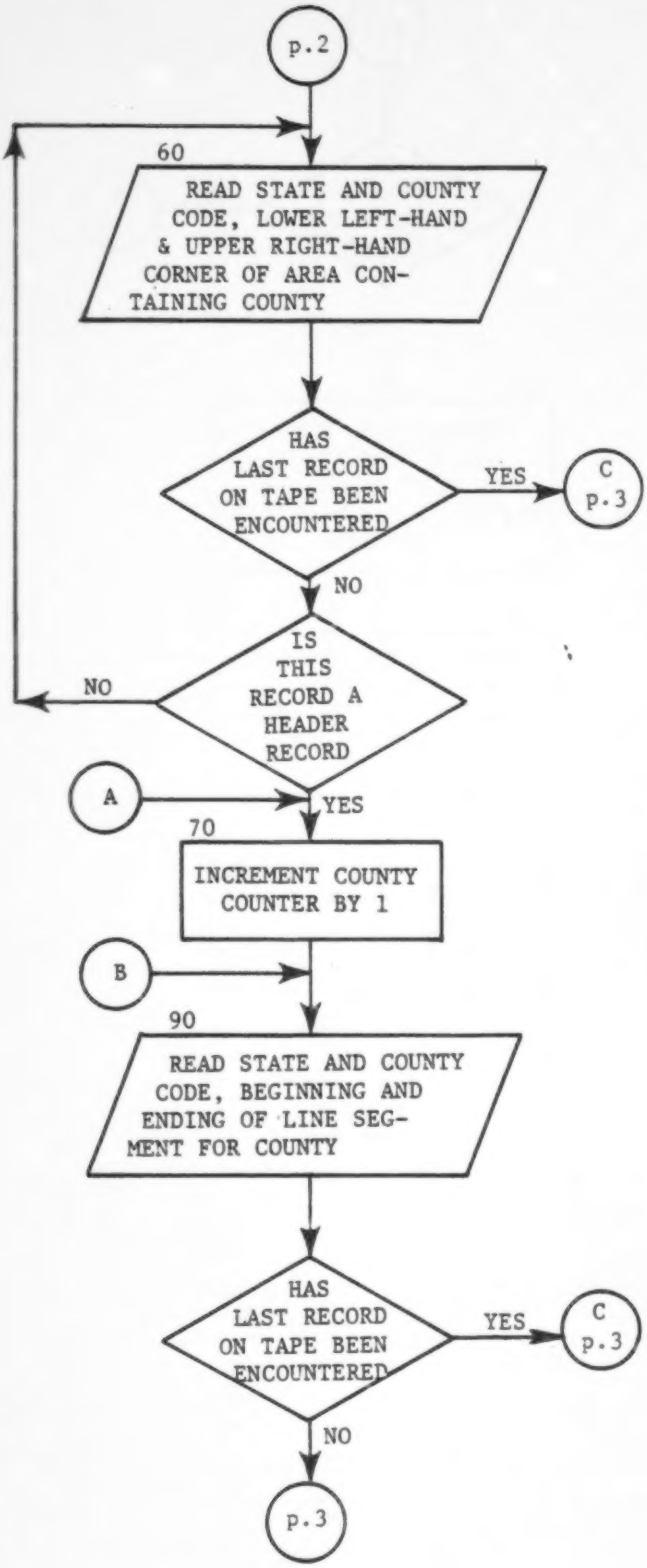
CAASE3
SUBROUTINE POPBOX
p.6


p.6
SET STARTING POSITION FOR LEGEND
CALL SYSTEM SUBROUTINE SYMBOL TO DRAW LEGEND
CALL SYSTEM SUBROUTINE NUMBER TO DRAW SCALE FACTOR
SET POSITION FOR TICK MARK LABEL
CALL SYSTEM SUBROUTINE NUMBER TO DRAW TICK MARK LABEL
SET VALUE OF MAXIMUM X & Y AXES TICKS SET POSITION OF TICK MARK LABEL
CALL SYSTEM SUBROUTINE NUMBER TO DRAW TICK MARK LABEL
p.7

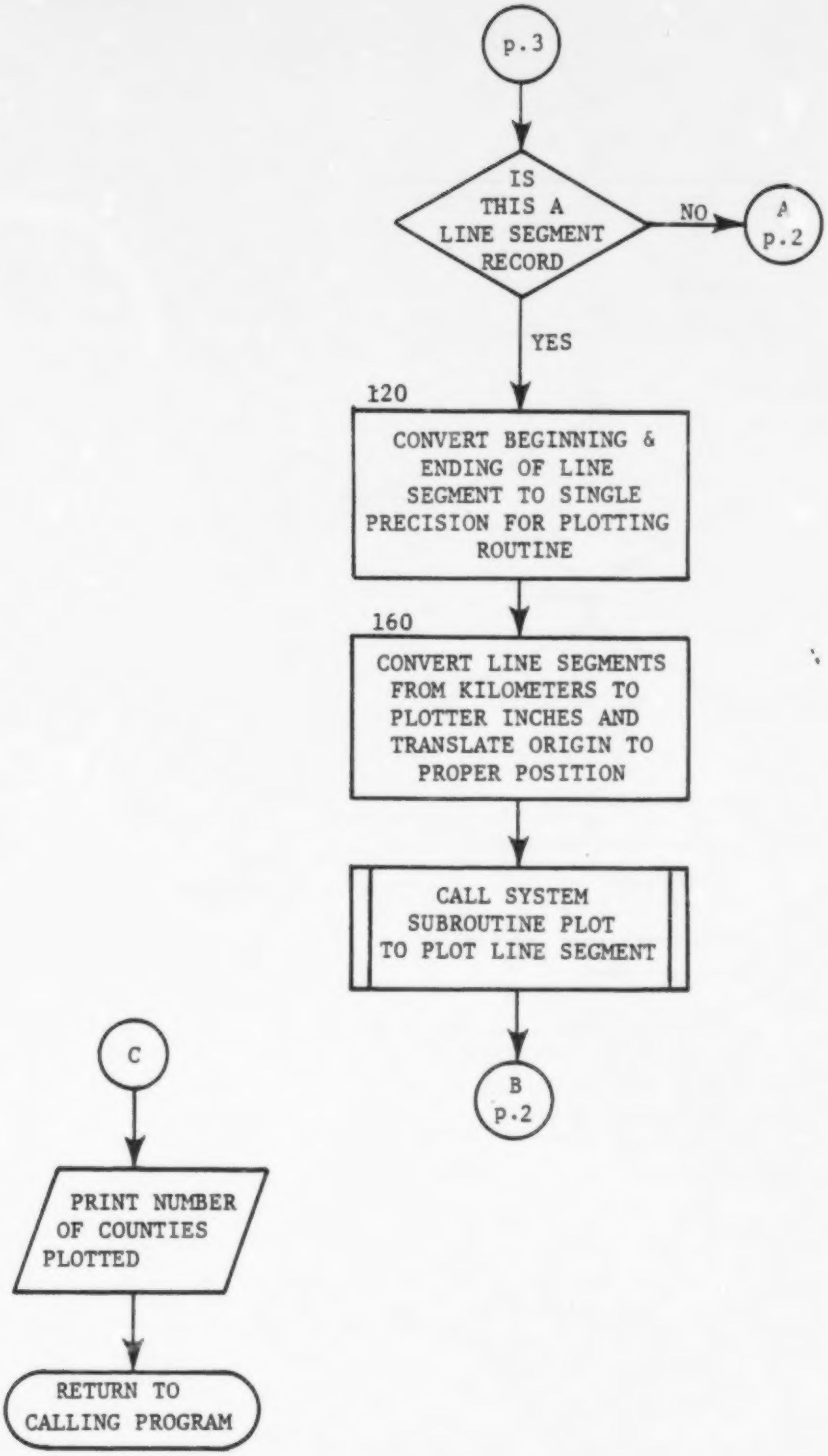

p.7
LOOP ON NUMBER OF GRID SQUARES IN COUNTY
(LOOP ENDS AT 300)
CALCULATE AND STORE X & Y COORDINATES OF CORNERS OF GRID SQUARE
CALL SYSTEM SUBROUTINE PLOT TO POSITION PEN AT LOWER LEFT HAND CORNER OF GRID
LOOP ON GRID SQUARE SIDES
(LOOP ENDS AT 200)
CALL SYSTEM SUBROUTINE PLOT TO DRAW GRID SQUARE SIDE
200 END OF LOOP
WRITE PLOTTER POINT LINE FOR GRID SQUARE
300 END OF LOOP
RETURN TO CALLING PROGRAM


SUBROUTINE EDPLOT
INITIALIZE ENUMERATION DISTRICT COUNTER TO ZERO
10
READ UTM COORDINATES AND TYPE OF ENUMERATION DISTRICT
HAS AN END OF FILE BEEN ENCOUNTERED
YES
NO
1000
PRINT NUMBER OF ENUMERATION DISTRICTS PLOTTED, AND THE COUNT FOR THE DIFFERENT TYPES OF ED's PLOTTED
RETURN TO CALLING PROGRAM
CONVERT COORDINATES FROM KILOMETERS TO PLOTTER INCHES AND SET SYMBOL TO BE USED
CALL SYSTEM SUBROUTINE SYMBOL TO PLACE ED SYMBOL IN POSITION ON MAP
INCREMENT ENUMERATION DISTRICT COUNT BY 1


SUBROUTINE COOUT
INITIALIZE STATE AND COUNTY CODES TO ZERO
50
CALL SYSTEM SUBROUTINE NEWPEN TO CHANGE PEN COLOR FOR COUNTY OUTLINE
INITIALIZE COUNTY COUNTER VARIABLE TO ZERO
READ NUMBER OF STATES TO BE PROCESSED
LOOP ON STATE COUNT (IX)
(LOOP ENDS AT 10)
READ NUMBER OF COUNTIES IN STATE
LOOP ON COUNTY COUNT (IY)
(LOOP ENDS AT 10)
READ COUNTY ID's
10 END OF LOOP
p.2


p.2
60
READ STATE AND COUNTY CODE, LOWER LEFT-HAND & UPPER RIGHT-HAND CORNER OF AREA CONTAINING COUNTY
HAS LAST RECORD ON TAPE BEEN ENCOUNTERED
YES
C p.3
NO
IS THIS RECORD A HEADER RECORD
NO
A
YES
70
INCREMENT COUNTY COUNTER BY 1
B
90
READ STATE AND COUNTY CODE, BEGINNING AND ENDING OF LINE SEGMENT FOR COUNTY
HAS LAST RECORD ON TAPE BEEN ENCOUNTERED
YES
C p.3
NO
p.3

CAASE3
SUBROUTINE COOUT
p.3


p.3
IS THIS A LINE SEGMENT RECORD
NO
A p.2
YES
120
CONVERT BEGINNING & ENDING OF LINE SEGMENT TO SINGLE PRECISION FOR PLOTTING ROUTINE
160
CONVERT LINE SEGMENTS FROM KILOMETERS TO PLOTTER INCHES AND TRANSLATE ORIGIN TO PROPER POSITION
CALL SYSTEM SUBROUTINE PLOT TO PLOT LINE SEGMENT
B p.2
C
PRINT NUMBER OF COUNTIES PLOTTED
RETURN TO CALLING PROGRAM

```
C****PROGRAM NAME: CAASE3
C*****THIS PROGRAM IS DESIGNED TO DRAW AREA SOURCE BOXES FOR ANY GIVEN
C      AQCR,   USING A SET OF DATA CARDS THAT DEFINE THE COORDINATES OF
C      THE LOWER-LEFT HAND CORNER OF THE BOX AND THE LENGTH OF THE SIDE.
       DIMENSION AQCR(5), XRAY(1800), YRAY(1800), SIDE(1800), ID(1800)
       DIMENSION CNTY(2)
       COMMON/BOXES/ XZERO, YZERO, SCALEX, AQCR, XRAY, YRAY, SIDE,
      1              N, XLONG, YLONG, IXTIC, IYTIC, TICINC, IPRINT,
      2              JRZONE, SCALEF
       COMMON /ED/ IEDFIL
       COMMON /CO/ ICOFIL, FROM, TO
       REAL*8 FROM(2), TO(2)
       INTEGER CNTY
       IREAD=5
       IPRINT=6
       IEDFIL=10
       ICOFIL=12
       NAQ=20
C
C*****INPUT
C      SCALEX--SCALING FACTOR TO CONVERT KILOMETER DISTANCES TO PLOTTER
C              INCHES
C      IXER----VARIABLE TO REQUEST PLOTTING OF STUDY AREA ENUMERATION
C              DISTRICTS.
C      ICO-----VARIABLE TO REQUEST PLOTTING OF COUNTY BOUNDARIES FOR
C              THE STUDY AREA
C      IBOX----AREA SOURCE GRID SQUARE NUMBER
C      XPT-----LOWER LEFT-HAND X COORDINATE FOR.THE GRID SQUARE
C      YPT-----LOWER LEFT-HAND Y COORDINATE FOR THE GRID SQUARE
C      S-------LENGTH OF THE SIDE OF THE GRID SQUARE
C      CNTY----FIPS STATE AND COUNTY CODES
C      IRZONE--REFERENCE (PRIMARY) UTM ZONE FOR THE RUN
C*****OUTPUT--A COMPUTER-DRAWN PLOT PICTURE OF THE GRID SQUARES FOR THE
C              ENTIRE AQCR; PLOTTING OF THE COUNTY BOUNDARIES AND
C              ENUMERATION DISTRICTS AS OPTIONS
C
       I=6.350013346
      TICINC=5.0
  100 READ (IREAD,5000,END=1000) SCALEX, IXER, ICO
 5000 FORMAT (F12.0,2I12)
      READ (IREAD,5010) AQCR
 5010 FORMAT (5A4)
      WRITE (IPRINT, 5015) AQCR
 5015 FORMAT ('1', 10X, 'STUDY AREA IS ', 5A4      )
      IF (IXER.GT.0) WRITE (IPRINT,5001)
 5001 FORMAT('0ENUMERATION DISTRICTS TO BE PLOTTED')
      IF (ICO.GT.0) WRITE (IPRINT,5002)
 5002 FORMAT('0COUNTY OUTLINES TO BE PLOTTED')
      SCALEF=SCALEX
      SCALEX=1/SCALEF
      READ (NAU,5005,END=1000) FROM, TO
 5005 FORMAT(4F5.0)
      IT=FROM(1)/5.
      XZERO=IT*5.
      IT=FROM(2)/5.
      YZERO=IT*5.
      IT=TO(1)/5.
      XLONG=IT*5.
      IT=TO(2)/5.
      YLONG=IT*5.
      IF ((XZERO-FROM(1)).GE.0.) XZERO=XZERO-5.
      IF ((YZERO-FROM(2)).GE.0.) YZERO=YZERO-5.
      IF ((XLONG-TO(1)).LE.0.) XLONG=XLONG+5.
      IF ((YLONG-TO(2)).LE.0.) YLONG=YLONG+5.
      IXTIC=(XLONG-XZERO)/TICINC+1
      IYTIC=(YLONG-YZERO)/TICINC+1
      T1=IXTIC*TICINC/SCALEX
      T2=IYTIC*TICINC/SCALEX
      WRITE (IPRINT,5018) FROM(1), FROM(2), TO(1), TO(2), T1, T2
 5018 FORMAT(/,11X,'EASTING  NORTHING',//,' MINIMUM',
     *2F10.0,//,' MAXIMUM',2F10.0,//,' PLOT WILL COVER',F5.1,' X ',
     *F5.1,' INCHES')
C*****READ IN CARDS WITH BOX NO., X,Y-COORDINATES OF LLH, AND SIDE
C     LENGTH UNTIL A BLANK CARD IS REACHED.
```

```
      WRITE (IPRINT,5016)
 5016 FORMAT(
     1'0', 7X, 'BOX    XPOINT    YPOINT      SIDE    STATE  COUNTY',/)
      DO 200 I=1,1800
      READ (NAQ,5020,END=250) IBOX, (CNTY(J),J=1,2), IRZONE, XPT, YPT, S
 5020 FORMAT(I5,6X,I3,I5,I3,2F10.5,F3.0)
      IF (IBOX.LE.0) GO TO 250
      N=I
      ID(I)=IBOX
      XRAY(I)= (XPT-XZERO) / SCALEX
      YRAY(I)= (YPT-YZERO) / SCALEX
      SIDE(I)= S/SCALEX
      WRITE (IPRINT,5025) IBOX, XPT, YPT, S, (CNTY(J), J=1,2)
 5025 FORMAT (1X, I9, 3F10.1, 2X, I4, I5)
  200 CONTINUE
C
C*****MAY HAVE EXCEEDED MAXIMUM NUMBER OF BOXES
      READ (NAQ,5020,END=250) IBOX
      IF (IBOX) 250,250,2030
C
C*****HAVE FILLED XRAY AND YRAY FOR THIS AREA.  TIME TO PLOT BOXES.
  250 CONTINUE
      CALL POPBOX
C*****OPTIONAL PLOT OF ENUMERATION DISTRICTS.
      IF (IXER.GT.0) CALL EDPLOT
C*****OPTIONAL PLOT OF COUNTY OUTLINES.
      IF (ICO.GT.0) CALL COOUT
      GO TO 100
C
 1000 WRITE(IPRINT,5040)
 5040 FORMAT('1GOOD FINISH')
C*****TOCC PLOTTING FORM
C     CALL PICSIZ(0.,0.)
C***** GENERAL PLOTTING FORM
      XLONG=(XLONG-XZERO)/SCALEX+3.0
      CALL PLOT(XLONG,1.0,999)
 1500 STOP
```

```
2030 WRITE (IPRINT,5035)
5035 FORMAT('THERE ARE MORE BOXES THAN STORAGE ALLOCATED. END JOB')
     GO TO 1500
     END
```

```
      SUBROUTINE PUPBOX
      DIMENSION AQCR(5), XRAY(1800), YRAY(1800), SIDE(1800)
      DIMENSION XX(2), YY(2), X(5), Y(5)
      COMMON/BOXES/ XZERO, YZERO, SCALEX, AQCR, XRAY, YRAY, SIDE,
     1               N, XLONG, YLONG, IXTIC, IYTIC, TICINC, IPRINT,
     2               JRZONE, SCALEF
C*****SET CONSTANTS NEEDED FOR PLOTTER USING INPUT VALUES.
C*****XLONG= TICINC * XMAX + 2 INCHES, YLONG= TICINC * YMAX + 3 INCHES.
      XTIC=IXTIC
      YTIC=IYTIC
      TICINC=TICINC/SCALEX
      XMAX=XTIC * TICINC
      YMAX=YTIC * TICINC
      SCALE=250000/SCALEF
      J=29
      I=29
      CALL PLOTS(I,J,14)
      CALL PLOT(0.,-30.,-3)
      CALL PLOT(3.0,0.75,-3)
      IND1=0
C
C*****DRAW THE X-AXIS.
   26 XX(1) = 0.0
      XX(2)= XMAX
      IF (IND1 .LE. 0) GO TO 30
      YY(1)= YMAX
      YY(2)= YMAX
      GO TO 32
   30 YY(1) = 0.0
      YY(2) = 0.0
   32 CALL PLOT(XX(1),YY(1),3)
      CALL PLOT(XX(2),YY(2),2)
C*****DRAW THE Y-AXIS.
      IF (IND1 .LE. 0) GO TO 40
      XX(1)= XMAX
      YY(2)=0.
      GO TO 42
   40 XX(2) = 0.0
      YY(2)= YMAX
   42 CALL PLOT(XX(1),YY(1),3)
      CALL PLOT(XX(2),YY(2),2)
C*****PLOT TIC MARKS ON X-AXIS
      XX(1) = 0.0
      IF (IND1 .LE. 0) GO TO 45
      YY(1)= YMAX
      YY(2)= YMAX + 0.1*SCALEF
      GO TO 47
   45 YY(1) = 0.0
      YY(2) = -0.1*SCALEF
   47 XX(2) = XX(1)
      CALL PLOT(XX(1),YY(1),3)
      CALL PLOT(XX(2),YY(2),2)
      DO 50 IDO=1,IXTIC
      XX(1)= XX(1) + TICINC
      XX(2) = XX(1)
      CALL PLOT(XX(1),YY(1),3)
      CALL PLOT(XX(2),YY(2),2)
   50 CONTINUE
C*****PLOT TIC MARKS ON Y-AXIS
      YY(1) = 0.0
      IF (IND1 .LE. 0) GO TO 55
      XX(1)= XMAX
      XX(2)= XMAX + 0.1*SCALEF
      GO TO 57
   55 XX(1) = 0.0
      XX(2) = -0.1*SCALEF
   57 YY(2)=YY(1)
      CALL PLOT(XX(1),YY(1),3)
      CALL PLOT(XX(2),YY(2),2)
      DO 100 IDO=1,IYTIC
      YY(1)= YY(1) + TICINC
      YY(2) = YY(1)
      CALL PLOT(XX(1),YY(1),3)
      CALL PLOT(XX(2),YY(2),2)
```

```
  100 CONTINUE
      IF (INDI .EQ. 1) GO TO 105
      INDI=1
      GO TO 26
C
C*****TIME TO PRINT LABELS.
  105 START= (XMAX-1.6*SCALEF) / 2.0
      XX(1)= START
      YY(1) = -0.34*SCALEF
      CALL SYMBOL(XX(1),YY(1),0.15*SCALEF,'KM  (EASTING)',0.0,13)
      START= (YMAX-1.7*SCALEF) / 2.0
      YY(1)= START
      XX(1) = -0.14*SCALEF
      CALL SYMBOL(XX(1),YY(1),0.15*SCALEF,'KM  (NORTHING)',90.0,14)
C*****TO CENTER THE TITLE, USE LENGTH OF 2ND. HEADG (3,2) AND OF
C     THE MAJOR HEADG (4,6).
      XSTART= (XMAX-7.8*SCALEF) / 2.0
      YSTART= (YMAX + 0.3*SCALEF)
      CALL SYMBOL(XSTART,YSTART,0.20*SCALEF,'AREA:  ',0.0,7)
      CALL SYMBOL(999.,999.,0.2*SCALEF,AQCR,0.0,20)
      XSTART= (XMAX-3.2*SCALEF)
      CALL SYMBOL(XSTART,YSTART,0.15*SCALEF,'SCALE:  1 KM:',0.0,13)
      CALL NUMBER(999.,999.,0.15*SCALEF,SCALE,0.0,-1)
      CALL SYMBOL(999.,999.,0.15*SCALEF,' KM',0.0,3)
      XX(1) = -0.6*SCALEF
      YY(1) = -0.3*SCALEF
      CALL NUMBER(XX(1),YY(1),0.15*SCALEF,XZERO,0.0,4)
      XX(1)=-1.5*SCALEF
      YY(1)=-0.075*SCALEF
      CALL NUMBER(XX(1),YY(1),0.15*SCALEF,YZERO,0.0,4)
      EPN= (5. * XTIC) + XZERO
      FPN= (5. * YTIC) + YZERO
      YY(1)= (YMAX-0.075*SCALEF)
      CALL NUMBER(XX(1),YY(1),0.15*SCALEF,FPN,0.0,4)
      XX(1)= (XMAX-0.6*SCALEF)
      YY(1)= -0.3*SCALEF
      CALL NUMBER(XX(1),YY(1),0.15*SCALEF,EPN,0.0,4)
```

```
C
C*****TIME TO DRAW BOXES.
C
      DO 300 K=1,N
      X(1)= XRAY(K)
      X(2)= X(1)
      X(3)= XRAY(K) + SIDE(K)
      X(4)= X(3)
      X(5)= X(1)
      Y(1)= YRAY(K)
      Y(2)= YRAY(K) + SIDE(K)
      Y(3)= Y(2)
      Y(4)= Y(1)
      Y(5)= Y(1)
C***** GENERAL PLOTTING FORM
      CALL PLOT(X(1),Y(1),3)
      DO 200 IDO=2,5
      CALL PLOT(X(IDO),Y(IDO),2)
  200 CONTINUE
  250 CONTINUE
  300 CONTINUE
      RETURN
      END
      SUBROUTINE EDPLOT
      COMMON /BOXES/ XZERO, YZERO, SCALEX, DUMMY1(5), DUMMY2(1800),
     1       DUMMY3(1800), DUMMY4(1800), IDUM, XLONG, YLONG,
     2       DUM1, DUM2, DUM3, IPRINT, JRZONE, SCALEF
      COMMON /ED/IEDFIL
C*****THIS SUBROUTINE READS THE CAASE1 ED FILE AND PLOTS SYMBOLS AT ED
C     LOCATIONS.  SYMBOL 1 IS USED FOR ACTUAL BUREAU OF THE CENSUS ED'S,
C     SYMBOL 5 FOR ED'S SCALED BY CAASE1 ACCORDING TO USER REQUEST, SYM-
C     BOL 9 FOR ED'S ENTERED SPECIFICALLY BY THE USER.
      DIMENSION MAARK(3), ICNTED(3)
      DATA MAARK/1,5,9/, ICNTED/0,0,0/
      ICOUNT=0
   10 READ (IEDFIL,5000,END=1000) EAST, ZNORTH, IMARK
 5000 FORMAT(164X,2F15.2,I4)
      M = MAARK(IMARK)
      Y = (ZNORTH - YZERO) / SCALEX
      X = (EAST - XZERO) / SCALEX
C***** GENERAL PLOTTING CALL
      CALL SYMBOL(X, Y, 0.05, M, 0.0, -1)
      ICOUNT=ICOUNT+1
      ICNTED(IMARK)=ICNTED(IMARK)+1
      GO TO 10
C*****FINISHED
 1000 WRITE (IPRINT,5005) ICOUNT, ICNTED
 5005 FORMAT(I5,' TOTAL ENUMERATION DISTRICTS PLOTTED',/,
     *       I5,' CENSUS ENUMERATION DISTRICTS',/,
     *       I5,' SCALED ENUMERATION DISTRICTS',/,
     *       I5,' USER ENUMERATION DISTRICTS')
      RETURN
      END
```

Reproduced from
best available copy.

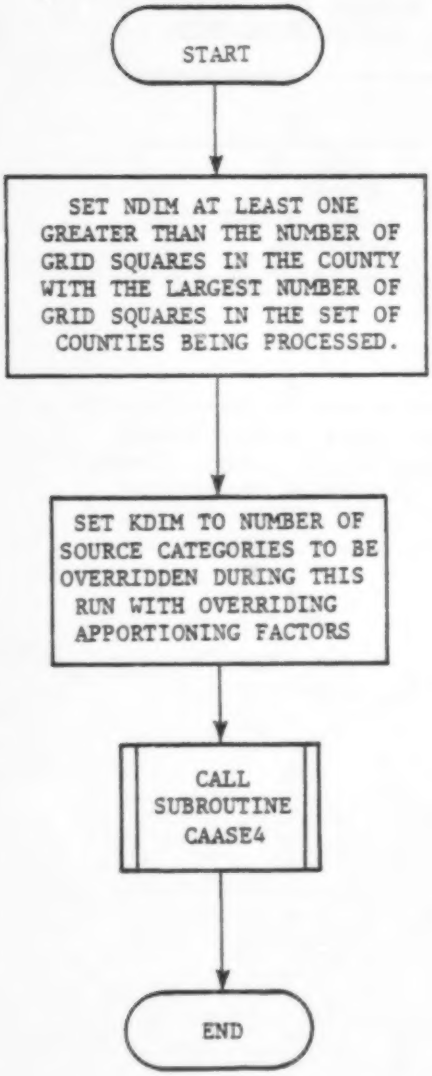
```
      SUBROUTINE COOUT
      COMMON /CO/ ICOFIL, FROM, TO
      COMMON /BOXES/ XZERO, YZERO, SCALEX, DUMMY1(5), DUMMY2(1800),
     1     DUMMY3(1800),DUMMY4(1800), IDUM, XLONG, YLONG,
     2     DUM1, DUM2, DUM3, IPRINT, JRZONE, SCALEF
      DIMENSION FROMP(2), TOP(2),FROM(2), TO(2)
      REAL*8 FROM, TO
      IST=0
      ICTY=0
C*****PLOT BOUNDARIES OF EACH COUNTY.  FIRST, CHANGE PEN TO BLUE.
C     FOR  GENERAL.
   50 CALL NEWPEN(3)
C*****BEGIN COUNTY-BY-COUNTY LOOP.
      ICOUNT=0
C*****FIND BEGINNING COUNTY RECORD ON TAPE.
C*****FIRST SKIP HEADER RECORDS.
      READ (ICOFIL,5001) IX
 5001 FORMAT(I4)
      DO 10 I=1,IX
      READ (ICOFIL,5001) IY
      DO 10 J=1,IY
      READ (ICOFIL,5001) IZ
   10 CONTINUE
   60 READ (ICOFIL,5005,END=1000) IST, ICTY, FROM, TO
 5005 FORMAT(I7,I3,4F10.1)
      IF (IST.EQ.0.OR.ICTY.EQ.0) GO TO 60
C*****COUNTY HEADER FOR COUNTY I FOUND.
   70 ICOUNT=ICOUNT+1
C*****PLOT COUNTY.
   90 READ (ICOFIL,5005,END=1000) IST, ICTY, FROM, TO
C*****CHECK FOR NEW COUNTY.
      IF( IST.NE.0) GO TO 70
  120 FROMP(1)=FROM (1)
      FROMP(2)=FROM (2)
      TOP(1)=TO (1)
      TOP(2)=TO (2)
C*****PLOT LINE SEGMENT
```

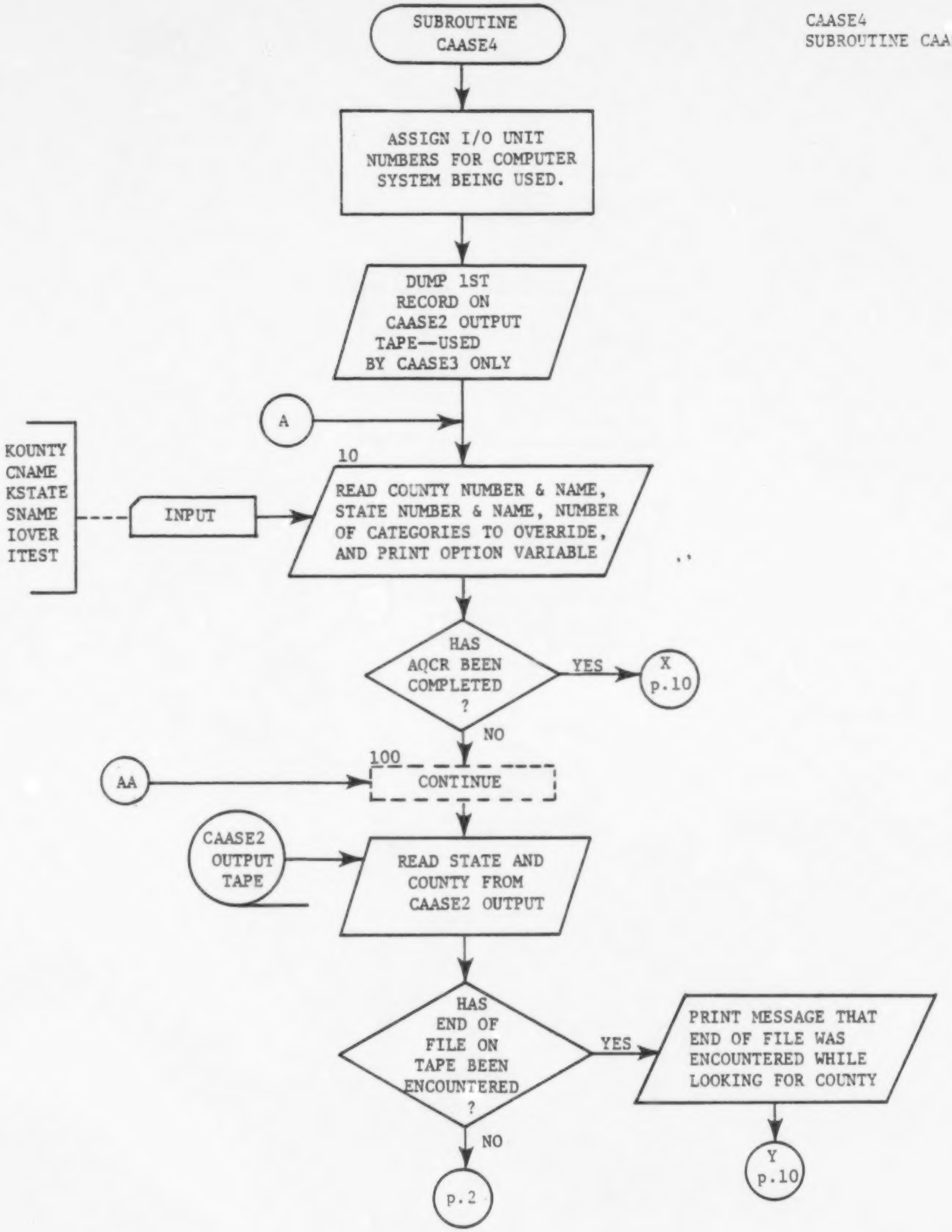
```
  160 FROMP(1)=(FROMP(1)-XZERO)/SCALEX
      FROMP(2)=(FROMP(2)-YZERO)/SCALEX
      TOP(1)=(TOP(1)-XZERO)/SCALEX
      TOP(2)=(TOP(2)-YZERO)/SCALEX
C***** GENERAL CALLS.
      CALL PLOT(FROMP(1),FROMP(2),3)
      CALL PLOT(TOP(1),TOP(2), 2)
C*****GO GET NEXT RECORD
      GO TO 90
C*****ALL COUNTIES FINISHED
 1000 WRITE (IPRINT,5050) ICOUNT
 5050 FORMAT(I5,' COUNTIES'' OUTLINES PLOTTED')
      RETURN
      END
```

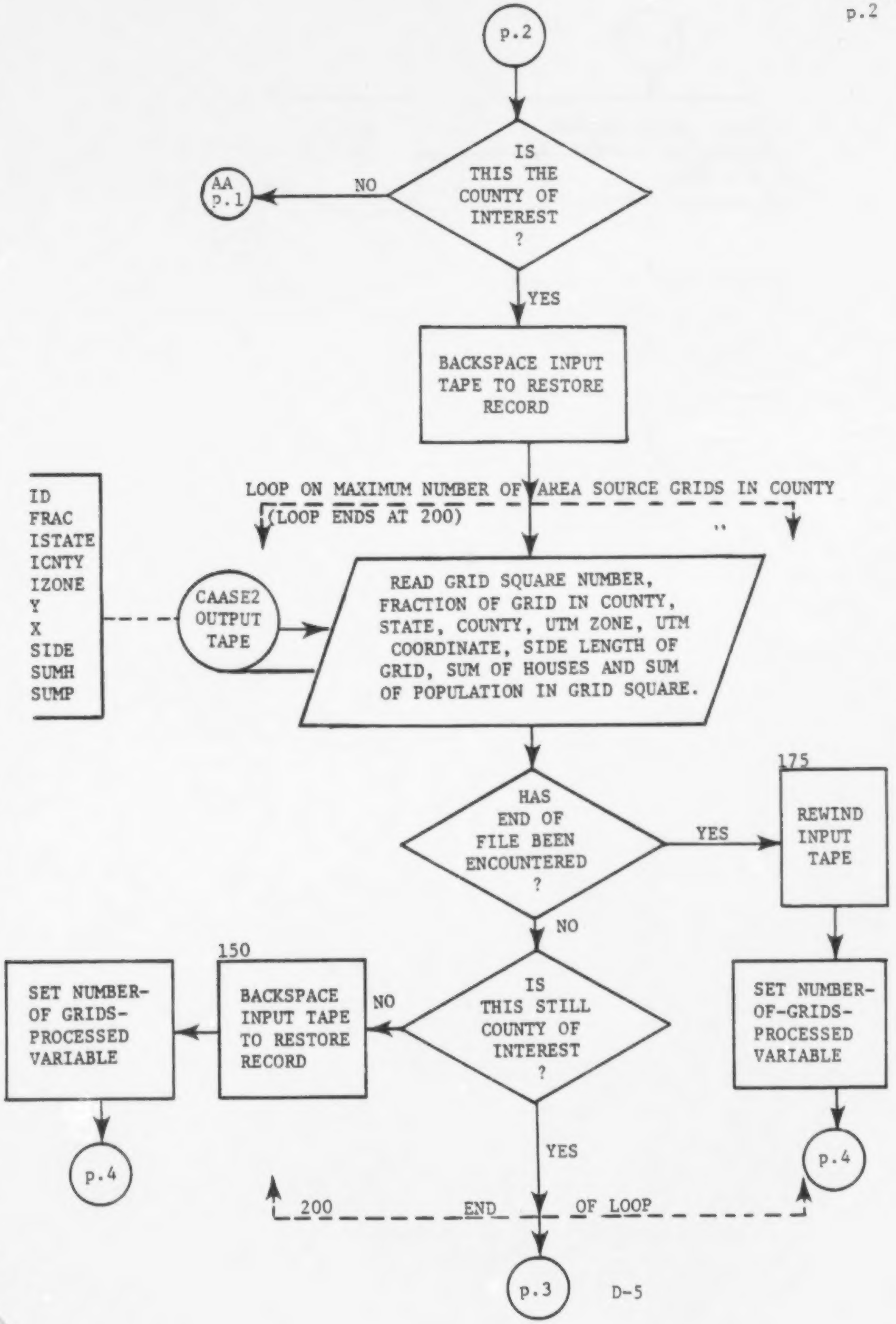
APPENDIX D

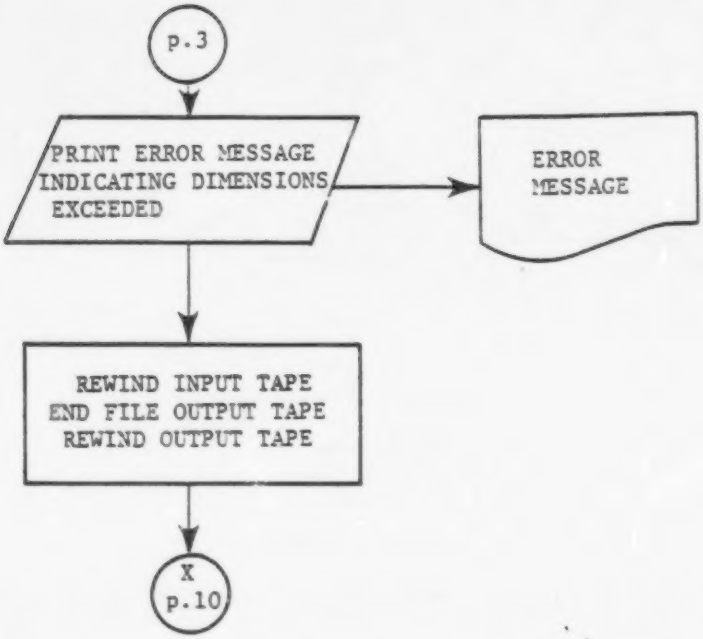
LOGICAL FLOWCHARTS AND FORTRAN SOURCE CODE LISTINGS
CAASE4 (and Subroutines)

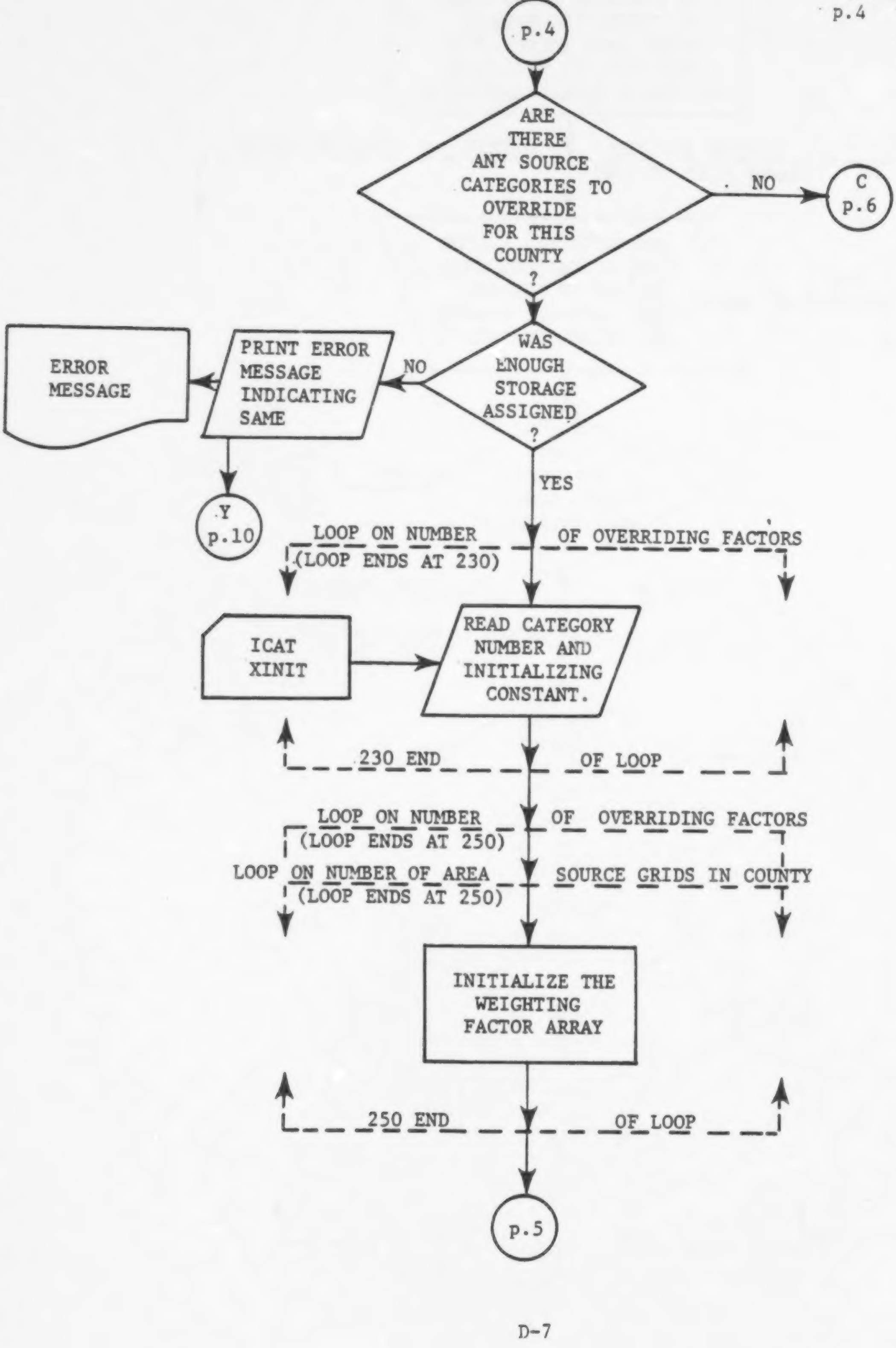
CAASE4
(DRIVER)

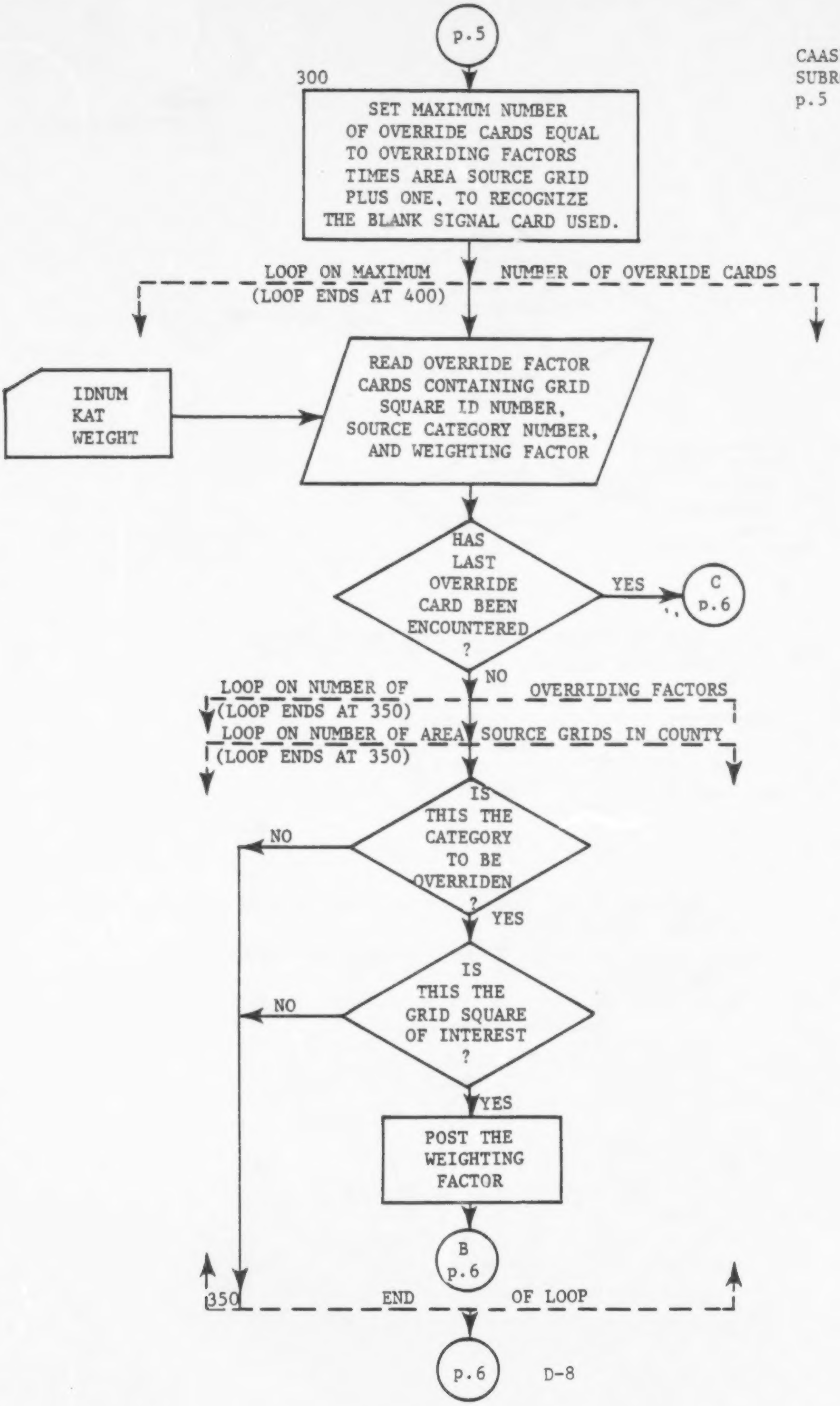

START
SET NDIM AT LEAST ONE GREATER THAN THE NUMBER OF GRID SQUARES IN THE COUNTY WITH THE LARGEST NUMBER OF GRID SQUARES IN THE SET OF COUNTIES BEING PROCESSED.
SET KDIM TO NUMBER OF SOURCE CATEGORIES TO BE OVERRIDDEN DURING THIS RUN WITH OVERRIDING APPORTIONING FACTORS
CALL SUBROUTINE CAASE4
END

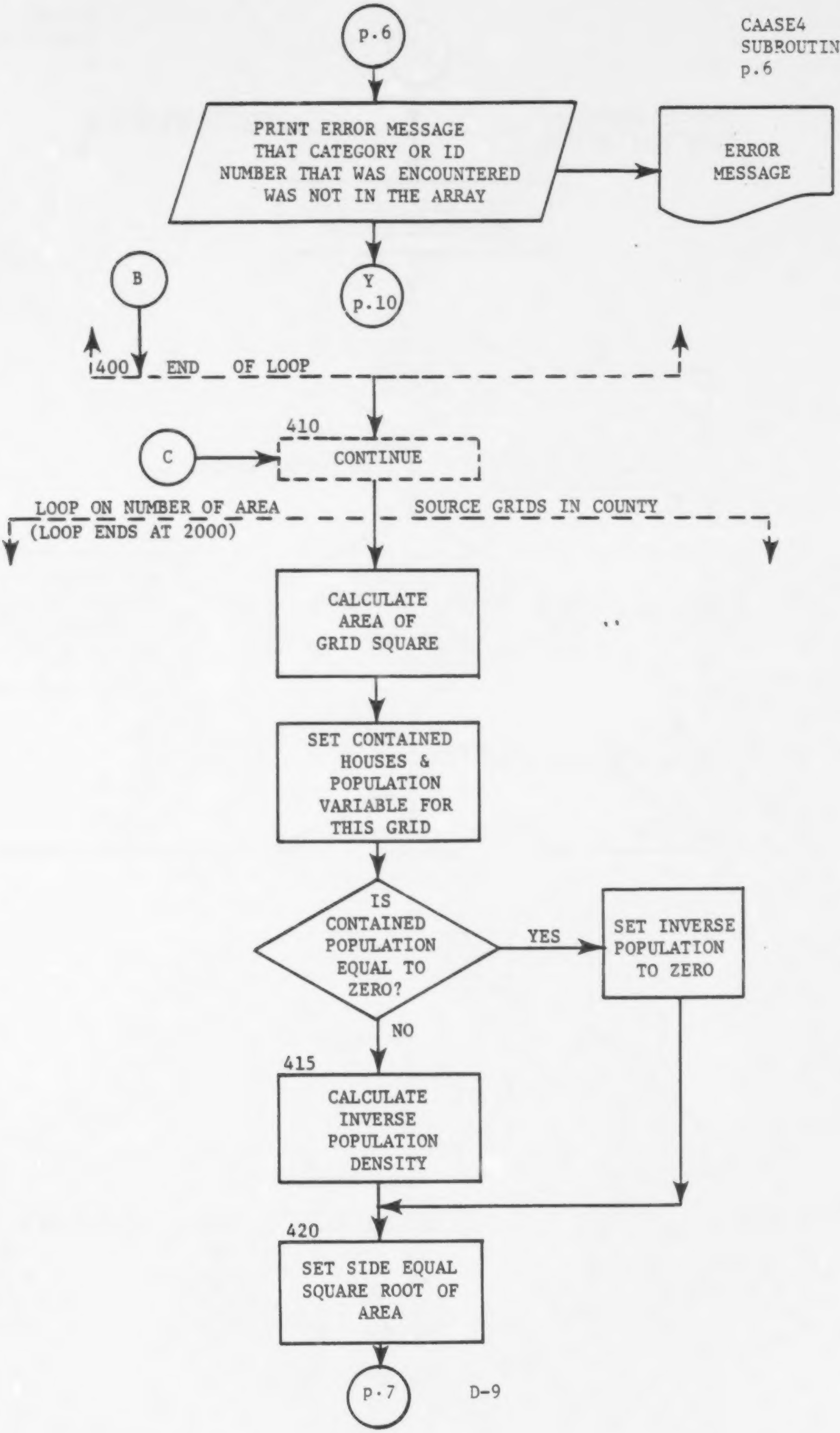

SUBROUTINE CAASE4
ASSIGN I/O UNIT NUMBERS FOR COMPUTER SYSTEM BEING USED.
DUMP 1ST RECORD ON CAASE2 OUTPUT TAPE—USED BY CAASE3 ONLY
A
10
KOUNTY
CNAME
KSTATE
SNAME
IOVER
ITEST
INPUT
READ COUNTY NUMBER & NAME, STATE NUMBER & NAME, NUMBER OF CATEGORIES TO OVERRIDE, AND PRINT OPTION VARIABLE
HAS AQCR BEEN COMPLETED ?
YES
X p.10
NO
100
AA
CONTINUE
CAASE2 OUTPUT TAPE
READ STATE AND COUNTY FROM CAASE2 OUTPUT
HAS END OF FILE ON TAPE BEEN ENCOUNTERED ?
YES
PRINT MESSAGE THAT END OF FILE WAS ENCOUNTERED WHILE LOOKING FOR COUNTY
Y p.10
NO
p.2

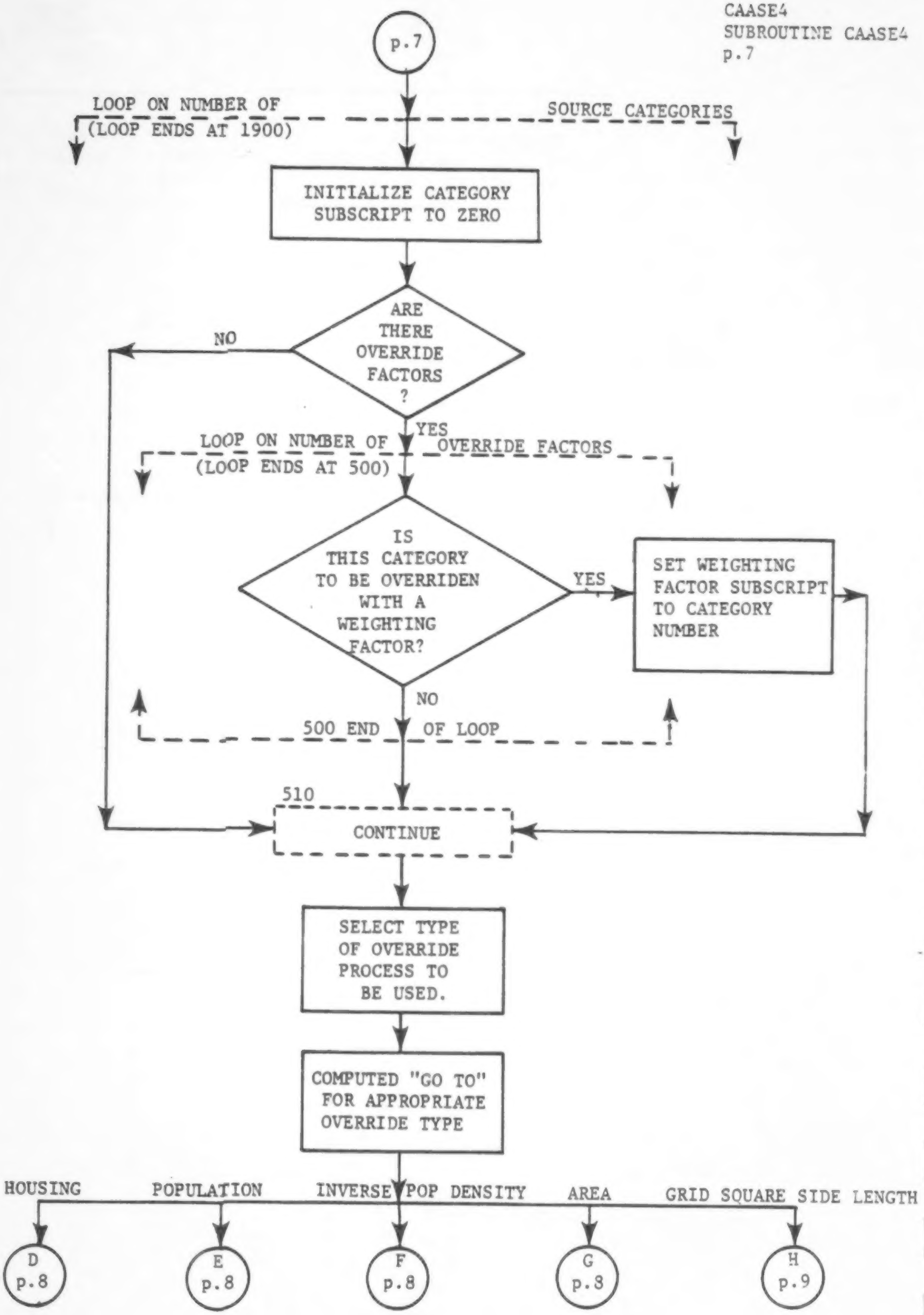

p.2
IS THIS THE COUNTY OF INTEREST ?
NO
AA p.1
YES
BACKSPACE INPUT TAPE TO RESTORE RECORD
LOOP ON MAXIMUM NUMBER OF AREA SOURCE GRIDS IN COUNTY
(LOOP ENDS AT 200)
ID
FRAC
ISTATE
ICNTY
IZONE
Y
X
SIDE
SUMH
SUMP
CAASE2 OUTPUT TAPE
READ GRID SQUARE NUMBER, FRACTION OF GRID IN COUNTY, STATE, COUNTY, UTM ZONE, UTM COORDINATE, SIDE LENGTH OF GRID, SUM OF HOUSES AND SUM OF POPULATION IN GRID SQUARE.
HAS END OF FILE BEEN ENCOUNTERED ?
YES
175
REWIND INPUT TAPE
NO
IS THIS STILL COUNTY OF INTEREST ?
NO
150
BACKSPACE INPUT TAPE TO RESTORE RECORD
SET NUMBER-OF GRIDS-PROCESSED VARIABLE
p.4
SET NUMBER-OF-GRIDS-PROCESSED VARIABLE
p.4
YES
200 END OF LOOP
p.3

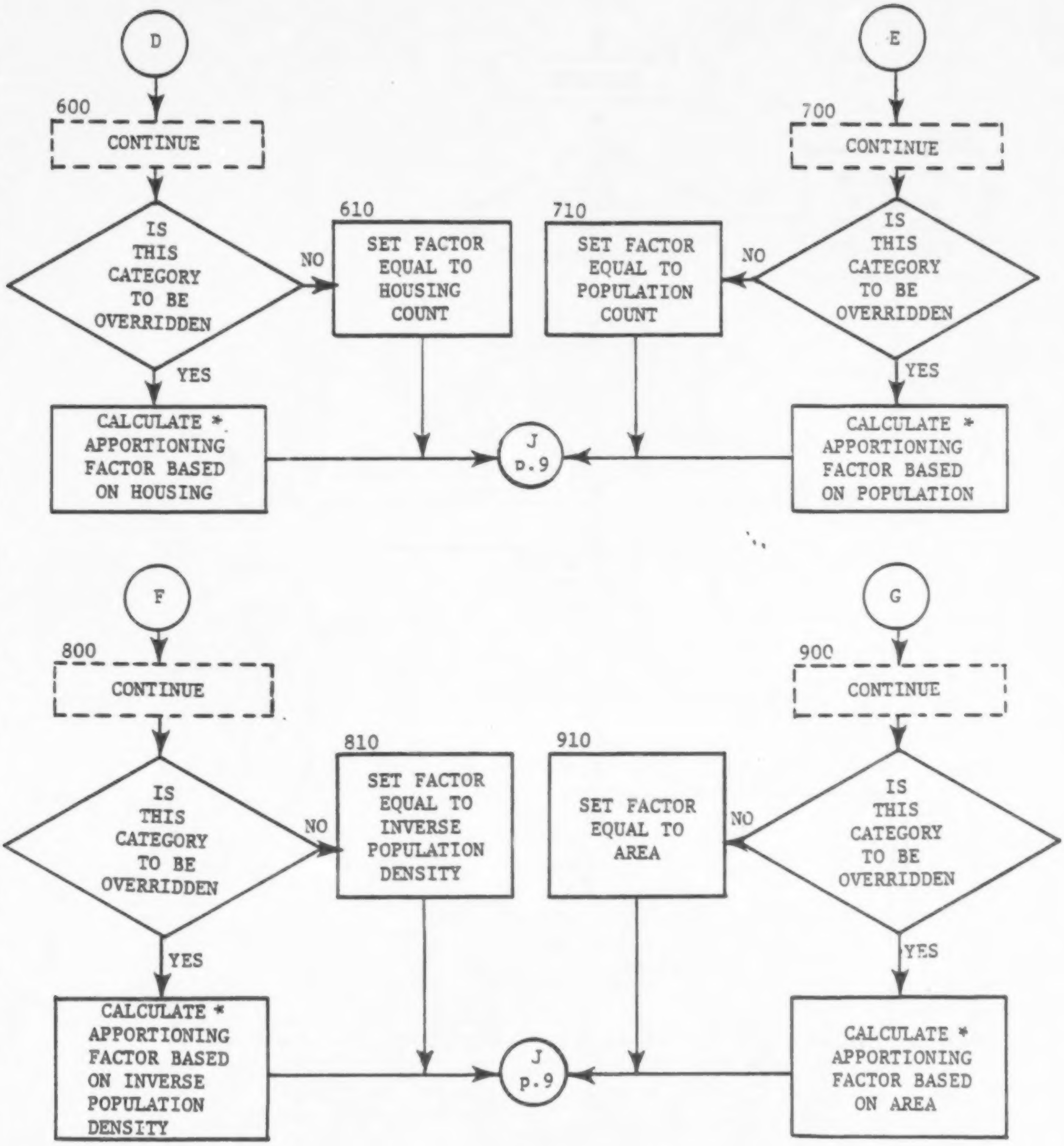

p.3
PRINT ERROR MESSAGE INDICATING DIMENSIONS EXCEEDED
ERROR MESSAGE
REWIND INPUT TAPE
END FILE OUTPUT TAPE
REWIND OUTPUT TAPE
X
p.10


p.4
ARE THERE ANY SOURCE CATEGORIES TO OVERRIDE FOR THIS COUNTY ?
NO
C p.6
WAS ENOUGH STORAGE ASSIGNED ?
NO
PRINT ERROR MESSAGE INDICATING SAME
ERROR MESSAGE
Y p.10
YES
LOOP ON NUMBER OF OVERRIDING FACTORS
(LOOP ENDS AT 230)
ICAT
XINIT
READ CATEGORY NUMBER AND INITIALIZING CONSTANT.
230 END OF LOOP
LOOP ON NUMBER OF OVERRIDING FACTORS
(LOOP ENDS AT 250)
LOOP ON NUMBER OF AREA SOURCE GRIDS IN COUNTY
(LOOP ENDS AT 250)
INITIALIZE THE WEIGHTING FACTOR ARRAY
250 END OF LOOP
p.5


p.5
300
SET MAXIMUM NUMBER OF OVERRIDE CARDS EQUAL TO OVERRIDING FACTORS TIMES AREA SOURCE GRID PLUS ONE, TO RECOGNIZE THE BLANK SIGNAL CARD USED.
LOOP ON MAXIMUM NUMBER OF OVERRIDE CARDS
(LOOP ENDS AT 400)
IDNUM
KAT
WEIGHT
READ OVERRIDE FACTOR CARDS CONTAINING GRID SQUARE ID NUMBER, SOURCE CATEGORY NUMBER, AND WEIGHTING FACTOR
HAS LAST OVERRIDE CARD BEEN ENCOUNTERED ?
YES
C
p.6
NO
LOOP ON NUMBER OF OVERRIDING FACTORS
(LOOP ENDS AT 350)
LOOP ON NUMBER OF AREA SOURCE GRIDS IN COUNTY
(LOOP ENDS AT 350)
IS THIS THE CATEGORY TO BE OVERRIDEN ?
NO
YES
IS THIS THE GRID SQUARE OF INTEREST ?
NO
YES
POST THE WEIGHTING FACTOR
B
p.6
350
END OF LOOP
p.6

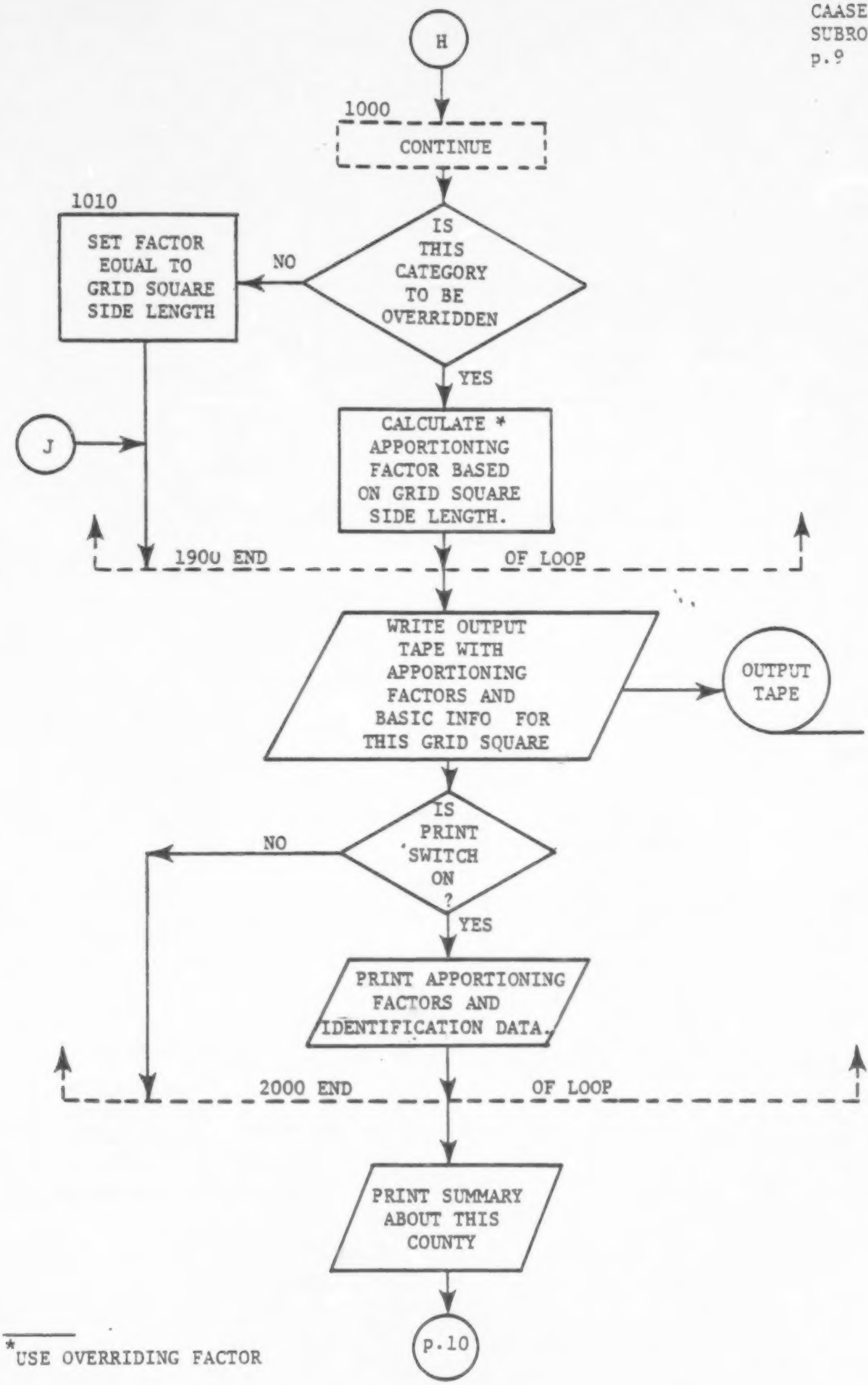

p.6
PRINT ERROR MESSAGE THAT CATEGORY OR ID NUMBER THAT WAS ENCOUNTERED WAS NOT IN THE ARRAY
ERROR MESSAGE
B
Y p.10
400 END OF LOOP
410
C
CONTINUE
LOOP ON NUMBER OF AREA SOURCE GRIDS IN COUNTY
(LOOP ENDS AT 2000)
CALCULATE AREA OF GRID SQUARE
SET CONTAINED HOUSES & POPULATION VARIABLE FOR THIS GRID
IS CONTAINED POPULATION EQUAL TO ZERO?
YES
SET INVERSE POPULATION TO ZERO
NO
415
CALCULATE INVERSE POPULATION DENSITY
420
SET SIDE EQUAL SQUARE ROOT OF AREA
p.7


p.7
LOOP ON NUMBER OF
SOURCE CATEGORIES
(LOOP ENDS AT 1900)
INITIALIZE CATEGORY SUBSCRIPT TO ZERO
ARE THERE OVERRIDE FACTORS ?
NO
YES
LOOP ON NUMBER OF
OVERRIDE FACTORS
(LOOP ENDS AT 500)
IS THIS CATEGORY TO BE OVERRIDEN WITH A WEIGHTING FACTOR?
YES
SET WEIGHTING FACTOR SUBSCRIPT TO CATEGORY NUMBER
NO
500 END
OF LOOP
510
CONTINUE
SELECT TYPE OF OVERRIDE PROCESS TO BE USED.
COMPUTED "GO TO" FOR APPROPRIATE OVERRIDE TYPE
HOUSING
POPULATION
INVERSE POP DENSITY
AREA
GRID SQUARE SIDE LENGTH
D p.8
E p.8
F p.8
G p.8
H p.9


D
600
CONTINUE
IS THIS CATEGORY TO BE OVERRIDDEN
NO
610
SET FACTOR EQUAL TO HOUSING COUNT
YES
CALCULATE * APPORTIONING FACTOR BASED ON HOUSING
J p.9
E
700
CONTINUE
IS THIS CATEGORY TO BE OVERRIDDEN
NO
710
SET FACTOR EQUAL TO POPULATION COUNT
YES
CALCULATE * APPORTIONING FACTOR BASED ON POPULATION
F
800
CONTINUE
IS THIS CATEGORY TO BE OVERRIDDEN
NO
810
SET FACTOR EQUAL TO INVERSE POPULATION DENSITY
YES
CALCULATE * APPORTIONING FACTOR BASED ON INVERSE POPULATION DENSITY
J p.9
G
900
CONTINUE
IS THIS CATEGORY TO BE OVERRIDDEN
NO
910
SET FACTOR EQUAL TO AREA
YES
CALCULATE * APPORTIONING FACTOR BASED ON AREA

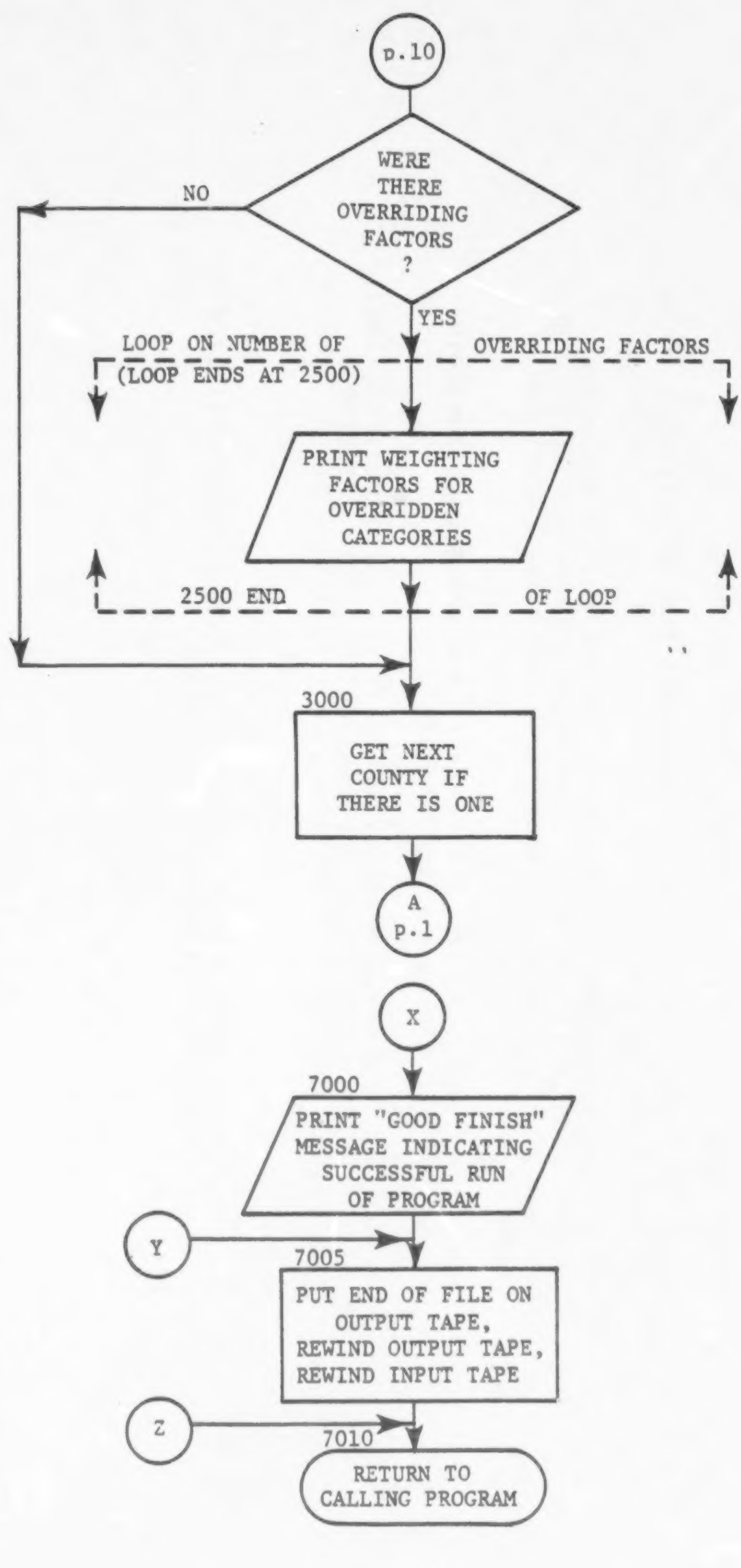
---

*USE OVERRIDING FACTOR


H
1000
CONTINUE
1010
SET FACTOR EQUAL TO GRID SQUARE SIDE LENGTH
NO
IS THIS CATEGORY TO BE OVERRIDDEN
YES
CALCULATE * APPORTIONING FACTOR BASED ON GRID SQUARE SIDE LENGTH.
J
1900 END OF LOOP
WRITE OUTPUT TAPE WITH APPORTIONING FACTORS AND BASIC INFO FOR THIS GRID SQUARE
OUTPUT TAPE
IS PRINT SWITCH ON ?
NO
YES
PRINT APPORTIONING FACTORS AND IDENTIFICATION DATA.
2000 END OF LOOP
PRINT SUMMARY ABOUT THIS COUNTY
p.10

---

*USE OVERRIDING FACTOR


p.10
WERE THERE OVERRIDING FACTORS ?
NO
YES
LOOP ON NUMBER OF OVERRIDING FACTORS
(LOOP ENDS AT 2500)
PRINT WEIGHTING FACTORS FOR OVERRIDDEN CATEGORIES
2500 END OF LOOP
3000
GET NEXT COUNTY IF THERE IS ONE
A p.1
X
7000
PRINT "GOOD FINISH" MESSAGE INDICATING SUCCESSFUL RUN OF PROGRAM
Y
7005
PUT END OF FILE ON OUTPUT TAPE, REWIND OUTPUT TAPE, REWIND INPUT TAPE
Z
7010
RETURN TO CALLING PROGRAM

```
C
C     PROGRAM NAME: CAASE4 DRIVER
C
C     DRIVER PROGRAM FOR CAASE4 TO SET DIMENSIONS
C
C     NDIM MUST BE AT LEAST ONE GREATER THAN THE NUMBER OF GRID SQUARES
C        IN THE COUNTY WITH THE MOST GRID SQUARES IN THE SET OF COUNTIES
C        BEING PROCESSED WITH THIS COMPUTER RUN.
C
C     KDIM IS THE NUMBER OF SOURCE CATEGORIES TO BE OVERRIDEN DURING
C     THIS RUN WITH OVERRIDING APPORTIIONING FACTORS.
C
C     OBJECTIVE TERMS WILL BE USED EXCLUSIVELY FOR APPORTIONING IF NO
C     OVERRIDES ARE REQUESTED
C
C     THESE DIMENSIONS MUST BE SPECIFIED AND THE DRIVER RECOMPILED
C     ANYTIME NDIM AND/OR KDIM ARE INCREASED. THEY DO NOT NEED TO BE
C     CHANGED IF DIMENSIONS ARE LARGER THAN NECESSARY EXCEPT FOR
C     COMPUTER STORAGE EFFICIENCY.
C
C     KDIM SETS DIMENSIONS FOR ICAT, XINIT, AND THE SECOND SUBSCRIPT
C     OF WGTFCT, ALL OTHERS ARE SET BY NDIM
C
      DIMENSION SUMH(100),SUMP(100),X(100),Y(100),SIDE(100),FRAC(100),
     1 STATE(100),COUNTY(100),UTZONE(100),WGTFCT(100,3 ),ID(100),
     2ISTATE(100),ICNTY(100),IZONE(100),ICAT( 3),XINIT( 3)
C
      NDIM=99
      KDIM=3
      CALL CAASE4(ID,SUMH,SUMP,X,Y,SIDE,FRAC,STATE,COUNTY,ISTATE,ICNTY,
     1UTZONE,IZONE,WGTFCT,ICAT,XINIT,NDIM,KDIM)
      CALL EXIT
      END
      SUBROUTINE CAASE4
     1           (ID,SUMH,SUMP,X,Y,SIDE,FRAC,STATE,COUNTY,ISTATE,ICNTY,
     2UTZONE,IZONE,WGTFCT,ICAT,XINIT,NDIM,KDIM)
C**** ROUTINE READS TAPE WRITTEN BY CAASE2 WHICH INCLUDES:
C          GRID SQUARE ID NUMBERS (ID)
C          UTM COORDINATES (EASTING AND NORTHING) OF LOWER LEFT HAND
C                CORNER FOR EACH GRID SQUARE (X AND Y)
C          UTM ZONE FOR EACH GRID SQUARE (UTZONE)
C          SIDE LENGTH IN KILOMETERS FOR EACH GRID SQUARE (SIDE)
C          FRACTION (FRAC) OF EACH GRID SQUARE IN COUNTY, ASSIGNED GT
C                ZERO, LE TO 1.0
C          STATE & COUNTY ASSOCIATED WITH EACH GRID SQUARE (STATE AND
C          COUNTY) FIPS CODE
      DIMENSION SUMH(NDIM),SUMP(NDIM),ID(NDIM),X(NDIM),Y(NDIM),
     1 FRAC(NDIM),SIDE(NDIM),ISTATE(NDIM),ICNTY(NDIM),IZONE(NDIM),
     2 WGTFCT(NDIM,KDIM),CNAME(5),SNAME(5),ICAT(KDIM),XINIT(KDIM),
     3 FACTOR(56),NAPORT(56)
C**** ALSO PASSED TO ROUTINE ARE THE DIMENSIONS FOR THE RUN WHERE:
C          NDIM=NUMBER OF GRID SQUARES IN THE COUNTY WITH THE LARGEST
C                 NUMBER OF SQUARES FOR THIS RUN (PLUS ONE)
C          KDIM=NUMBER OF SOURCE CATEGORIES TO BE OVERRIDEN
C
C          ITEST = WHETHER OR NOT TO PRINT THE FACTORS COMPUTED - IF NOT
C          ZERO, PRINTING WILL OCCUR.
C****      WEIGHT FACTORS ARE ASSUMED TO BE EQUAL TO 1.0 EXCEPT FOR
C          THOSE CATEGORIES TO BE OVERRIDDEN.
C
C          FOR THOSE SOURCE CATEGORIES TO BE OVERRIDDEN, READ IN THE
C          SOURCE CATEGORY NUMBER AND EITHER A ZERO OR A 1.0 FOR
C          INITIALIZATION, E.G. IF AIRPORT OPERATIONS ARE TO BE
C          OVERRIDDEN AND EMISSIONS APPORTIONED TO ONLY THOSE GRID
C          SQUARES INDICATED, THEN READ IN A CARD WITH EACH APPLICABLE
C          CATEGORY NUMBER (33,34, OR35) AND A 0.0 TO CAUSE THE
C          INITIALIZATION OF THE WEIGHTING FACTOR FOR EACH GRID SQUARE
C          TO BE SET TO ZERO...
C
C**** AN INPUT CARD TO OVERRIDE AN OBJECTIVE WEIGHTING FACTOR
```

```
C     REQUIRES THE GRID SQUARE ID NUMBER, THE SOURCE CATEGORY NUMBER,
C     AND THE WEIGHT ASSIGNED- WEIGHTS OF 0 TO 10 OR 0.0 TO 1.0 ARE
C     SUGGESTED
C
C     SET GO TO BRANCHES AS A FUNCTION OF SOURCE CATEGORY
C
      DATA NAPORT /6*1,14*2,1,2*2,1,5*2,3,2,3,5,3*4,4*5,2*2,2*3,2*2,
     1 2*3,4,6*3,2/
C
C**** DIMENSIONS ARE A FUNCTION OF THE NUMBER OF GRID SQUARES IN THE
C     COUNTY BEING PROCESSED (NDIM) AND THE NUMBER OF SOURCE CATEGORIES
C     TO BE OVERRIDDEN (KDIM).  THE USER IS CAUTIONED TO PROVIDE AN
C     ADEQUATE NUMBER , E.G., IF THE LARGEST NUMBER OF SQUARES IN ANY
C     COUNTY BEING PROCESSED IS 50, THEN DIMENSIONS SHOULD BE NO LESS
C     THAN 51, AND THE VARIABLE 'NDIM' SHOULD BE SET TO 50
C
C
C     ASSIGN I/O UNIT NUMBERS
C
      IREADR=1
C
C      INPUT TAPE (FROM CAASE2)
C
      ITAPEN=4
C
C     OUTPUT TAPE (INPUT TO CAASE5)
C
      ITAPEO=6
      IPRINT=3
      NDIMP1=NDIM+1
C
C**** DUMP FIRST RECORD ON CAASE2 OUTPUT TAPE-- IT IS USED BY CAASE3
C            ONLY.
C
      READ(ITAPEN,4990) DUM,DUM,DUM
 4990 FORMAT(3A4)
C
```

```
C      START PROCESSING A COUNTY
C
C      READ COUNTY AND STATE NAME AND NUMBER (FIPS-CENSUS), NUMBER OF
C      CATEGORIES TO OVERRIDE, AND WHETHER PRINTER OUTPUT IS WANTED.
C
   10  READ(IREADR,5000,END=7000) KOUNTY,CNAME,KSTATE,SNAME,IOVER,ITEST
 5000  FORMAT(I5,5X,5A4,I5,5X,5A4,2I5)
C
C      STOP ON BLANK CARD FOR COUNTY (END OF RUN SIGNAL)
C
       IF (KOUNTY.EQ.0) GO TO 7000
C
C      READ IN CAASE2 OUTPUT DATA FOR COUNTY BEING PROCESSED. SHOULD
C      BE IN ORDER, I.E. COUNTIES IN ORDER AND ALL RECORDS FOR EACH
C      COUNTY IN SEQUENTIAL RECORDS, INSURE THAT NEXT RECORD IS COUNTY
C      WANTED
C           SUMH=SUM OF HOUSES IN EACH GRID SQUARE
C           SUMP=SUM OF POPULATION IN EACH GRID SQUARE
  100  CONTINUE
       READ(ITAPEN,5010,END=6950) JSTATE,JKNTY
 5010  FORMAT(11X,I3,I5)
       IF(JSTATE.NE.KSTATE.OR.JKNTY.NE.KOUNTY) GO TO 100
C      FOUND COUNTY WANTED
       BACKSPACE ITAPEN
C
C      READ DATA FOR THIS COUNTY,MAXIMUM WILL BE NDIM IN NUMBER
C
       DO 200 I=1,NDIMP1
       READ(ITAPEN,5020,END=175) ID(I),FRAC(I),ISTATE(I),ICNTY(I),
      1IZONE(I), X(I), Y(I), SIDE(I), SUMH(I), SUMP(I)
 5020  FORMAT(I5,F6.5,I3,I5,I3,2F10.0,F3.0,2E13.5)
       IF(ICNTY(I).EQ.KOUNTY.AND.ISTATE(I).EQ.KSTATE) GO TO 200
C
C      EITHER END OF FILE ENCOUNTERED OR ENCOUNTERED A DIFFERENT COUNTY
C
  150  BACKSPACE ITAPEN
C
```

```
C      NAREAS IS NUMBER OF GRID SQUARES THIS COUNTY
C
       NAREAS=I-1
       GO TO 210
  175  REWIND ITAPEN
       NAREAS=I-1
       GO TO 210
  200  CONTINUE
C
C      ERROR, EXCEEDING DIMEMSIONS REQUESTED, ERROR OFF
C
       WRITE(IPRINT,5030) KOUNTY,CNAME,KSTATE,SNAME,NDIM,NDIMP1
 5030  FORMAT('1NUMBER OF GRID SQUARES CONTAINED IN',3X,I5,5X,5A4,' COUNT
      1Y IN THE STATE OF',3X,I5,5X,5A4/'0EXCEEDS DIMEMSIONS SPECIFIED',5X
      2,'NDIM=',I5,5X,'AND',I5,'  GRID SQUARES HAVE BEEN READ WITHOUT ENC
      3OUNTERING EITHER'/'0ANOTHER COUNTY OR AN END OF FILE, CORRECT NDIM
      4 AND RESUBMIT JOB')
       REWIND ITAPEN
       END FILE ITAPEO
       REWIND ITAPEO
       GO TO 7000
  210  CONTINUE
C
C      ARE THERE ANY SOURCE CATEGORIES TO OVERRIDE FOR THIS COUNTY
C
       IF(IOVER.EQ.0) GO TO 410
C
C      READ THE CATEGORY NUMBER AND THE INITIALIZING CONSTANT (I.E. 1.0
C          OR 0.0) FOR EACH.
C
C
C          CHECK FIRST ON ENOUGH STORAGE ASSIGNED
C
       IF(IOVER.LE.KDIM) GO TO 225
       WRITE(IPRINT,5035) IOVER,KDIM
 5035  FORMAT('0NOT ENOUGH STORAGE ALLOCATED FOR OVERRIDE FACTORS, IOVER=
      1',I5,'  AND KDIM=',I5,/'0 INCREASE KDIM AND RESUBMIT RUN')
      GO TO 7005
  225 DO 230 I=1,IOVER
      READ (IREADR,5040) ICAT(I), XINIT(I)
 5040 FORMAT (I5,F5.0)
  230 CONTINUE
C
C     INITIALIZE THE WEIGHTING FACTOR ARRAY, CAN BE USED TO SET ALL
C     GRID SQUARES FOR A PARTICULAR SOURCE CATEGORY TO 0. AND THEN PUT
C     IN OVERRIDE FACTORS FOR ONLY THOSE GRID SQUARES TO APPORTION THE
C     SOURCE CATEGORY INTO
C
      DO 250 J=1,IOVER
      DO 250 I=1,NAREAS
      WGTFCT(I,J)=XINIT(J)
  250 CONTINUE
C
C     OVERRIDE FACTORS FOLLOW WHERE EACH CARD CONTAINS THE GRID SQUARE
C     ID NUMBER, THE SOURCE CATEGORY NUMBER, AND THE ASSIGNED WEIGHTING
C     FACTOR NUMBER
C
C     A BLANK CARD, I.E., A BLANK GRID SQUARE NUMBER SIGNALS THE END
C     OF OVERRIDE CARDS. THE MAXIMUM NUMBER OF OVERRIDE CARDS FOR A
C     COUNTY IS (OBVIOUSLY) IOVER (NUMBER OF CATEGORIES TO OVERRIDE)
C     TIMES NAREAS (NUMBER OF GRID SQUARES IN THE COUNTY BEING
C     PROCESSED) PLUS 1 TO RECOGNIZE THE BLANK SIGNAL CARD USED.
C
  300  LOOP=NAREAS*IOVER+1
      DO 400 L=1, LOOP
      READ (IREADR,5050) IDNUM,KAT,WEIGHT
 5050 FORMAT(2I10,F10.0)
      IF(IDNUM.EQ.0) GO TO 410
      DO 350 J=1,IOVER
      DO 350 I=1,NAREAS
      IF(ICAT(J).NE.KAT) GO TO 350
      IF(IDNUM.NE.ID(I)) GO TO 350
C
C     FOUND THE GRID SQUARE AND CATEGORY, POST THE WEIGHTING FACTOR
```

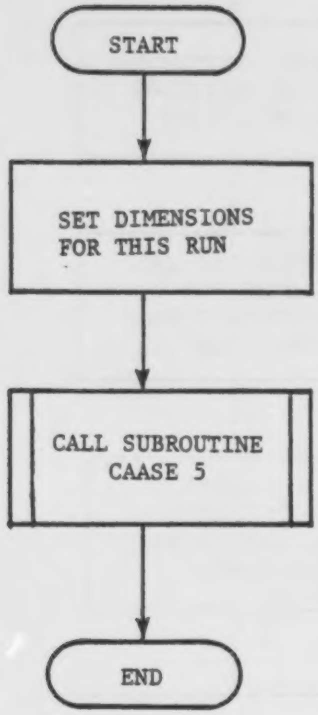
```
C
      WGTFCT(I,J)=WEIGHT
      GO TO 400
  350 CONTINUE
C
C     COULD ONLY FALL THROUGH IF A CATEGORY OR ID NUMBER WAS ENCOUNTERED
C         WHICH WAS NOT IN THE ARRAYS. PROBABLE KEYPUNCH ERROR.
C
      WRITE(IPRINT,5060) IDNUM,KAT,WEIGHT
 5060 FORMAT('0TROUBLE WITH WEIGHTING FACTORS - TRIED TO OVERRIDE WITH G
     1RID SQUARE NUMBER, CATEGORY NUMBER, AND WEIGHTING FACTOR NUMBER='/
     22I10,F10.2/'0CHECK FOR KEYPUNCH ERRORS AND RESUBMIT JOB'//)
      GO TO 7005
  400 CONTINUE
C
C     COULD ONLY FALL THROUGH IF TOO MANY OVERRIDE CARDS ARE BEING
C     SUBMITTED FOR THE DIMENSIONS KDIM, NDIM -- ERROR OFF
C
      WRITE (IPRINT,5065) LOOP
 5065 FORMAT('0TROUBLE WITH WEIGHTING -- ONLY ALLOWED FOR',I10,'  CARDS
     1(GRID SQUARE-SOURCE CATEGORY COMBINATIONS)'/'0CHECK KDIM, NDIM, AN
     2D OVERRIDE CARDS -- FATAL ERROR THIS RUN')
      GO TO 7005
C
C     NOW READY TO ASSIGN APPORTIONING FACTORS
C
  410 CONTINUE
C
C      AREA
C
      DO 2000 I=1,NAREAS
      AREA= SIDE(I)*SIDE(I)*FRAC(I)
C     CONTAINED HOUSES
C
      SUM1=SUMH(I)
C
C     CONTAINED POPULATION
```

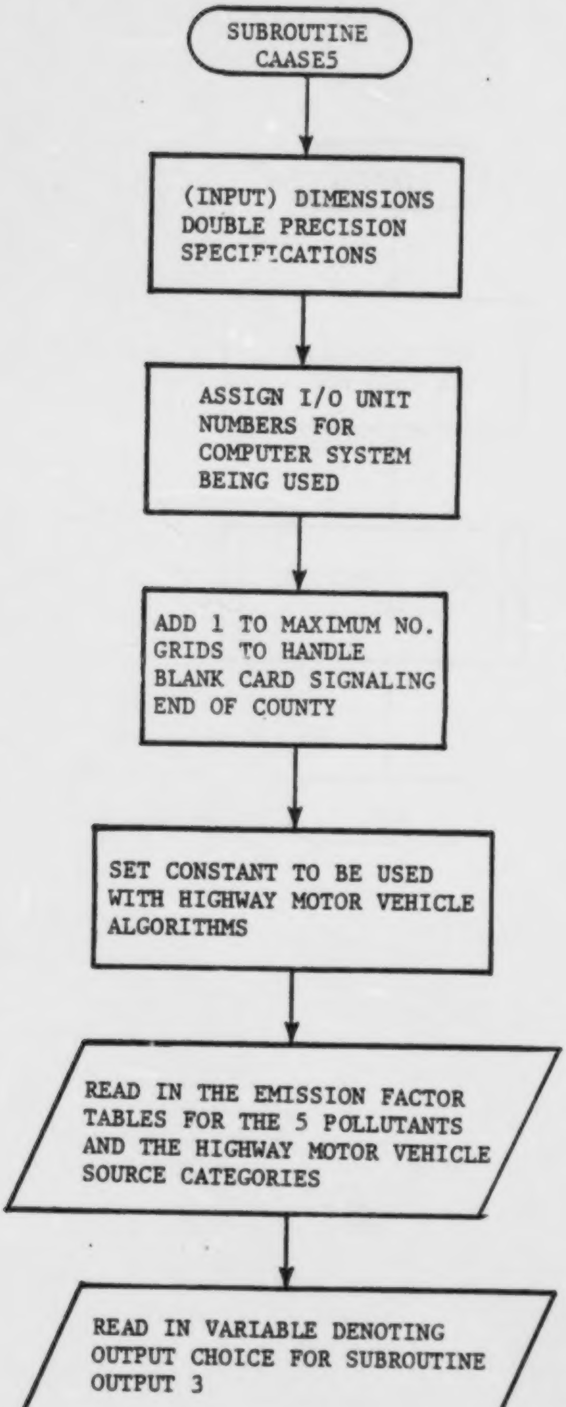
```
C
      SUM2 = SUMP(I)
C
C**** INVERSE POPULATION DENSITY WEIGHTED BY GRID SQUARE SIZE AND
C     FRACTION OF GRID SQUARE IN COUNTY IF NOT TOTALLY INSIDE A COUNTY
C
      IF(SUM2.NE.0.) GO TO 415
      SUM3=0.
      GO TO 420
  415 SUM3=(AREA/SUM2)*AREA
C
C     EFFECTIVE SIDE LENGTH OF AREA WITHIN THIS COUNTY
C
  420 SIDELN= SQRT(AREA)
C
C     LOOP THROUGH THE SOURCE CATEGORIES
C
      DO 1900 J=1,56
C
C**** IS THIS CATEGORY TO BE OVERRIDDEN WITH A WEIGHTING FACTOR?
C
      ISUB=0
      IF(IOVER.EQ.0) GO TO 510
C
C     FIND WEIGHT FACTOR FOR THIS CATEGORY
C
C
      DO 500 K=1,IOVER
      IF(ICAT(K).NE.J) GO TO 500
      ISUB=K
      GO TO 510
  500 CONTINUE
  510 CONTINUE
C
C     SELECT TYPE OF OVERRIDE TO USE WHERE:
C
C     ITYPE = 1   HOUSING
```

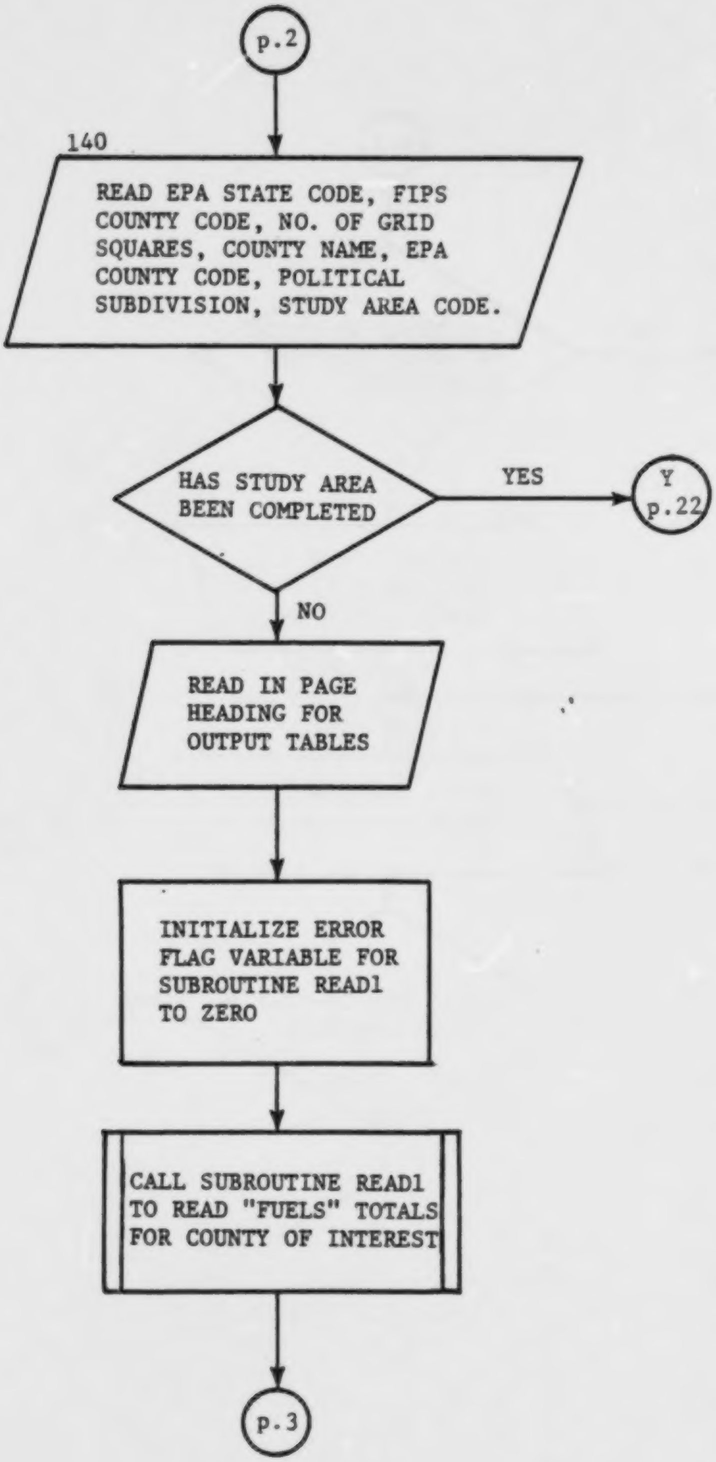
```
C              = 2   POPULATION
C              = 3   INVERSE POPULATION DENSITY
C              = 4   AREA
C              = 5   GRID SQUARE SIDE LENGTH
C
C
C     BRANCH ACCORDING TO WHICH CATEGORY ON THIS ITERATION
C
      ITYPE = NAPORT (J)
      GO TO (600,700,800,900,1000) , ITYPE
  600 CONTINUE
C
C     HOUSING
C
      IF (ISUB.EQ.0) GO TO 610
      FACTOR(J) = SUM1*WGTFCT(I,ISUB)
      GO TO 1900
  610 FACTOR(J)= SUM1
      GO TO 1900
  700 CONTINUE
C
C     POPULATION
C
      IF (ISUB.EQ.0) GO TO 710
      FACTOR(J) = SUM2*WGTFCT(I,ISUB)
      GO TO 1900
  710 FACTOR(J) = SUM2
      GO TO 1900
  800 CONTINUE
C
C     INVERSE POPULATION DENSITY
C
      IF(ISUB.EQ.0) GO TO 810
      FACTOR(J) = SUM3*WGTFCT(I,ISUB)
      GO TO 1900
  810 FACTOR(J) = SUM3
      GO TO 1900
  900 CONTINUE
C
C      AREA
C
       IF(ISUB.EQ.0) GO TO 910
       FACTOR(J)= AREA*WGTFCT(I,ISUB)
       GO TO 1900
  910 FACTOR(J) = AREA
       GO TO 1900
 1000 CONTINUE
C
C      GRID SQUARE SIDE LENGTH
C
       IF (ISUB.EQ.0) GO TO 1010
       FACTOR(J)=SIDELN*WGTFCT(I,ISUB)
       GO TO 1900
 1010 FACTOR(J) = SIDELN
 1900 CONTINUE
C
C**** OUTPUT TAPE WITH APPORTIONING FACTORS AND BASIC INFO FOR THIS GRID
C      SQUARE ( FOR INPUT TO CAASES )
C
       WRITE(ITAPEO,5100) ID(I),FRAC(I),ISTATE(I),SNAME,ICNTY(I),CNAME,
      1IZONE(I),X(I),Y(I),SIDE(I),AREA,FACTOR
 5100 FORMAT(I5,F6.5,I3,5A4,I5,5A4,I3,2F10.0,2F10.2,56E13.5)
C
C**** IF PRINT SWITCH (ITEST) IS ON, PRINT FACTORS AND IDENTIFICATION
C      DATA
C
       IF(ITEST.EQ.0) GO TO 2000
       WRITE(IPRINT,5200) ID(I),FRAC(I),ISTATE(I),SNAME,ICNTY(I),
      1CNAME,IZONE(I),X(I),Y(I),SIDE(I),AREA,FACTOR
 5200 FORMAT(/////'0 FOR ID,FRAC,STATE,COUNTY,ZONE,X,Y,SIDE,AND AREA='/
      1'0',I5,F10.5,I5,5A4,I5,5A4,I3,2F10.0,2F10.2/'0FACTORS='//
      2(8E13.5))
       WRITE(IPRINT,5205) SUM2,SUM1,SUM3,SIDELN
 5205 FORMAT('0'/' CONTAINED POPULATION =',F10.0,3X,'CONTAINED HOUSING =
     1',F10.0,3X,'AREA WEIGHTED INVERSE POPULATION DENSITY =',E13.5/
     2'0SQUARE ROOT OF AREA (EFFECTIVE SIDE LENGTH) =',F10.4)
 2000 CONTINUE
      WRITE(IPRINT,5210) SNAME,CNAME,NAREAS,IOVER
 5210 FORMAT('0STATE AND COUNTY  ',5A4,5X,5A4,' HAD',I10,'  GRID SQUARES
     1'/    I10,'  SOURCE CATEGORIES WERE OVERRIDDEN' )
      IF(IOVER.EQ.0) GO TO 3000
C
C**** OUTPUT WEIGHTING FACTORS FOR OVERRIDDEN CATEGORIES
C
      DO 2500 J=1,IOVER
      WRITE(IPRINT,5220) ICAT(J),XINIT(J)
 5220 FORMAT('1 CATEGORY', I5,'  WAS INITIALIZED WITH', F10.0,2X,
     1 'FOR ALL GRID SQUARES IN THIS  COUNTY'/'0THE FOLLOWING ARE ID AND
     2 WEIGHTING FACTOR PAIRS FOR THIS CATEGORY'///)
      WRITE(IPRINT,5330) (ID(I),WGTFCT(I,J),I=1,NAREAS)
 5330 FORMAT(I10,F10.2,I10,F10.2,I10,F10.2,I10,F10.2,I10,F10.2,I10,
     1 F10.2)
 2500 CONTINUE
 3000 WRITE(IPRINT,5400)
 5400 FORMAT('1')
C
C**** GET NEXT COUNTY IF THERE IS ONE
C
      GO TO 10
 6950 WRITE(IPRINT,5340) SNAME,CNAME
 5340 FORMAT('0ENCOUNTERED END OF FILE ON INPUT TAPE WHEN LOOKING FOR ',
     15X,5A4,5X,5A4)
      GO TO 7005
 7000 WRITE(IPRINT,5350)
 5350 FORMAT('1GOOD FINISH')
 7005 END FILE ITAPEO
      REWIND ITAPEO
      REWIND ITAPEN
 7010 RETURN
      END
```

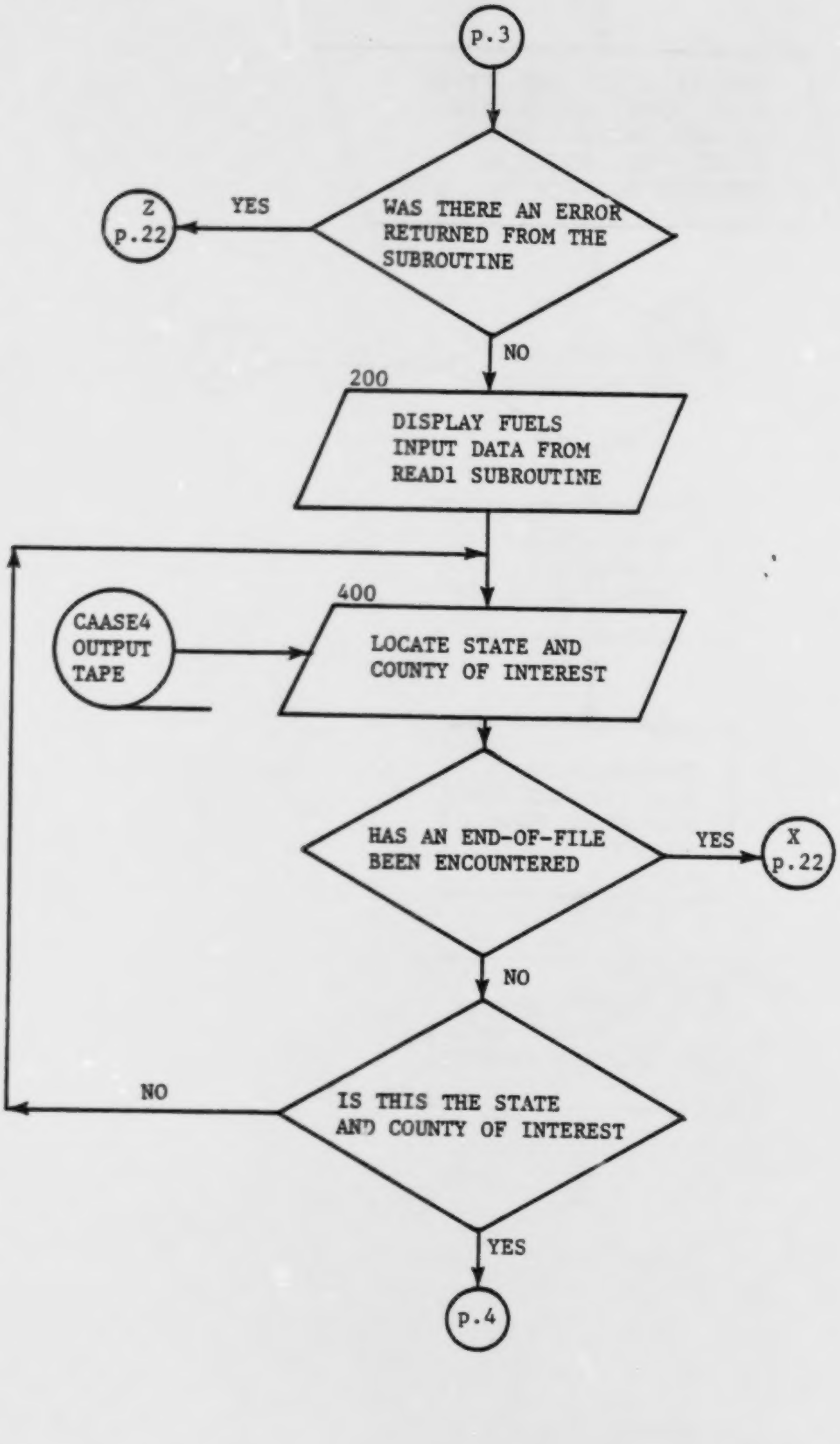
APPENDIX E

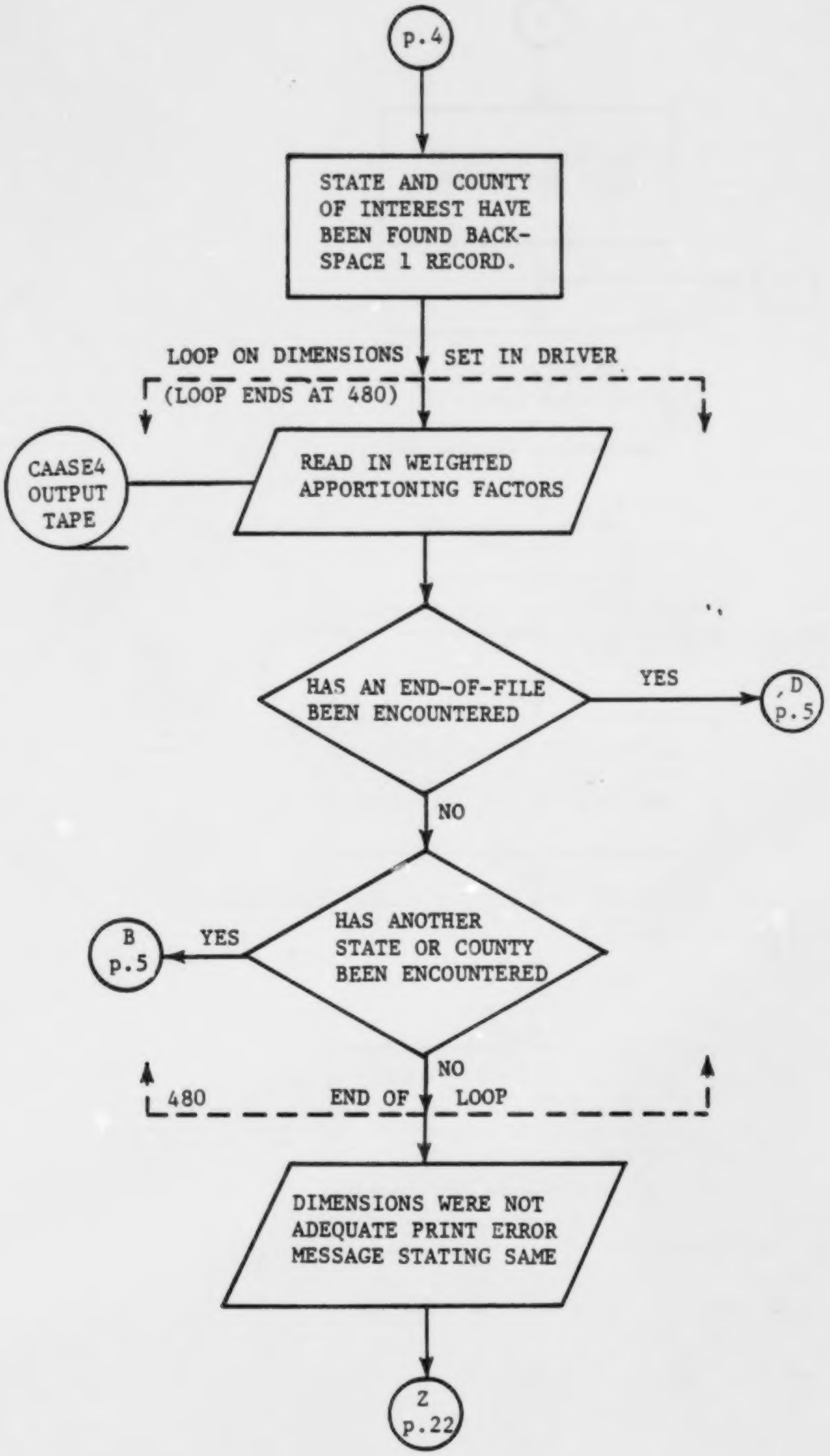
LOGICAL FLOWCHARTS AND FORTRAN SOURCE CODE LISTINGS
CAASE5 (and Subroutines)

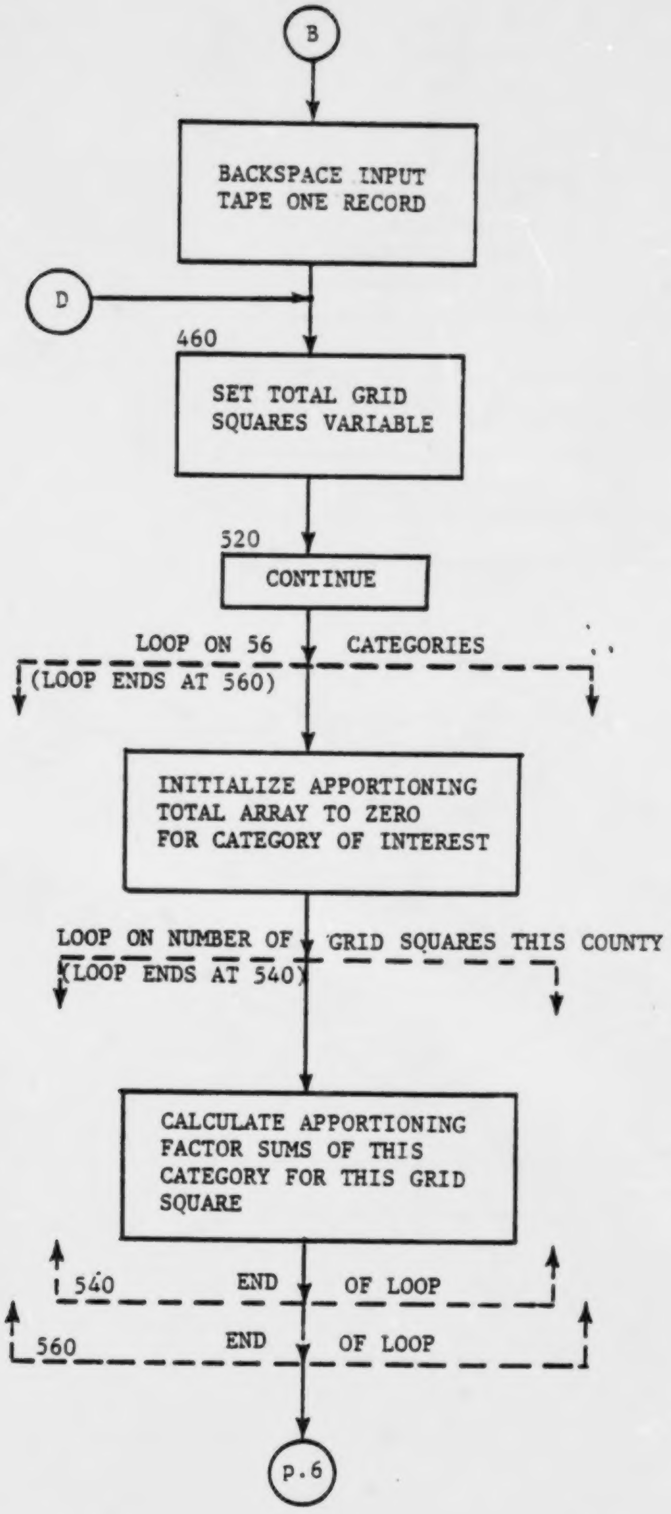

START
SET DIMENSIONS FOR THIS RUN
CALL SUBROUTINE CAASE 5
END

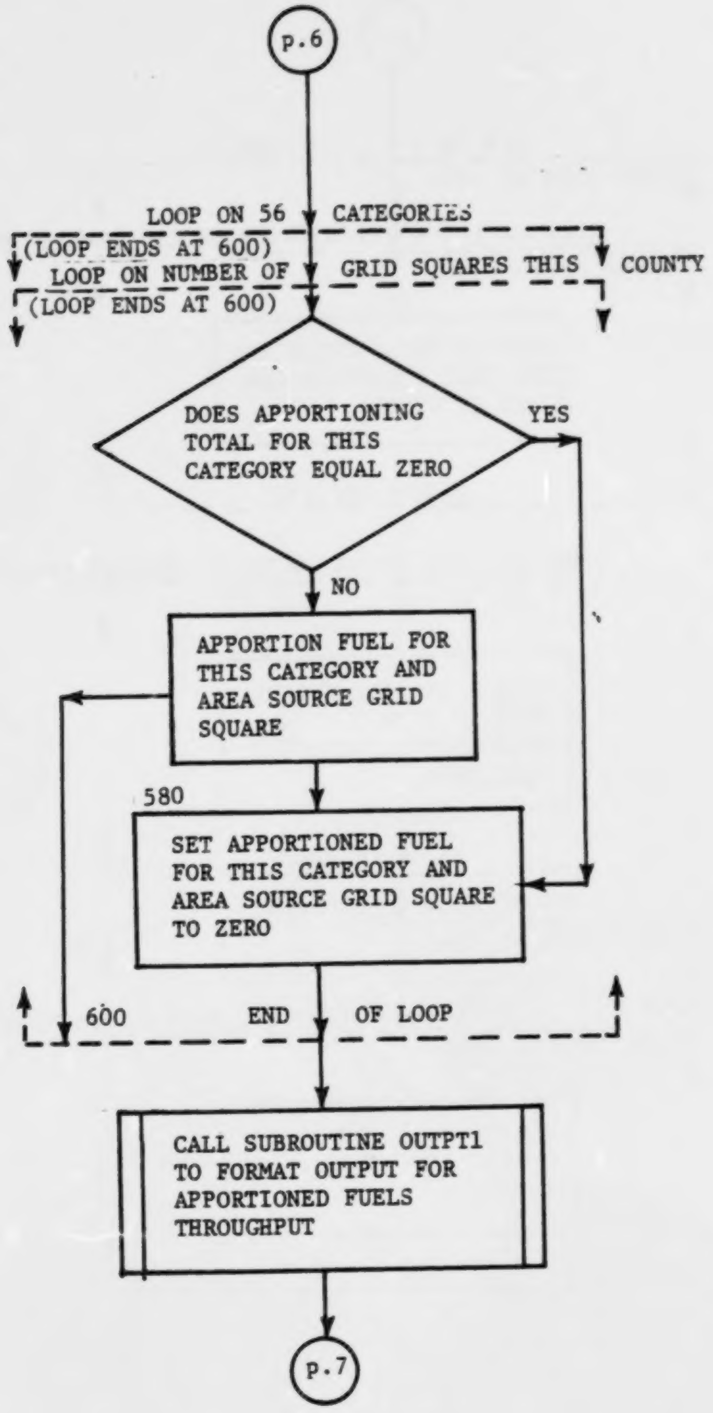

SUBROUTINE CAASE5
(INPUT) DIMENSIONS DOUBLE PRECISION SPECIFICATIONS
ASSIGN I/O UNIT NUMBERS FOR COMPUTER SYSTEM BEING USED
ADD 1 TO MAXIMUM NO. GRIDS TO HANDLE BLANK CARD SIGNALING END OF COUNTY
SET CONSTANT TO BE USED WITH HIGHWAY MOTOR VEHICLE ALGORITHMS
READ IN THE EMISSION FACTOR TABLES FOR THE 5 POLLUTANTS AND THE HIGHWAY MOTOR VEHICLE SOURCE CATEGORIES
READ IN VARIABLE DENOTING OUTPUT CHOICE FOR SUBROUTINE OUTPUT 3
p.2


p.2
140
READ EPA STATE CODE, FIPS COUNTY CODE, NO. OF GRID SQUARES, COUNTY NAME, EPA COUNTY CODE, POLITICAL SUBDIVISION, STUDY AREA CODE.
HAS STUDY AREA BEEN COMPLETED
YES
Y p.22
NO
READ IN PAGE HEADING FOR OUTPUT TABLES
INITIALIZE ERROR FLAG VARIABLE FOR SUBROUTINE READ1 TO ZERO
CALL SUBROUTINE READ1 TO READ "FUELS" TOTALS FOR COUNTY OF INTEREST
p.3

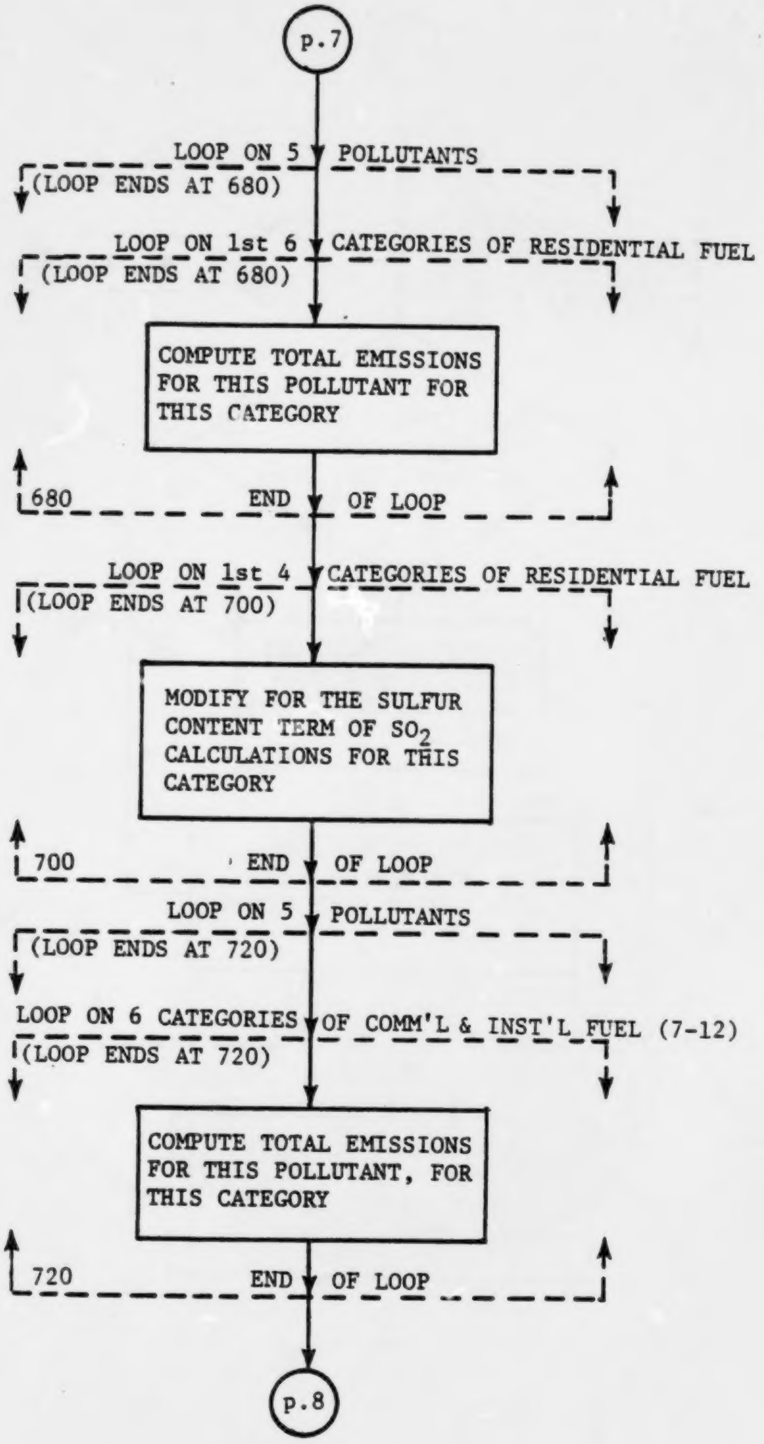

p.3
WAS THERE AN ERROR RETURNED FROM THE SUBROUTINE
YES
Z p.22
NO
200
DISPLAY FUELS INPUT DATA FROM READ1 SUBROUTINE
400
CAASE4 OUTPUT TAPE
LOCATE STATE AND COUNTY OF INTEREST
HAS AN END-OF-FILE BEEN ENCOUNTERED
YES
X p.22
NO
IS THIS THE STATE AND COUNTY OF INTEREST
NO
YES
p.4

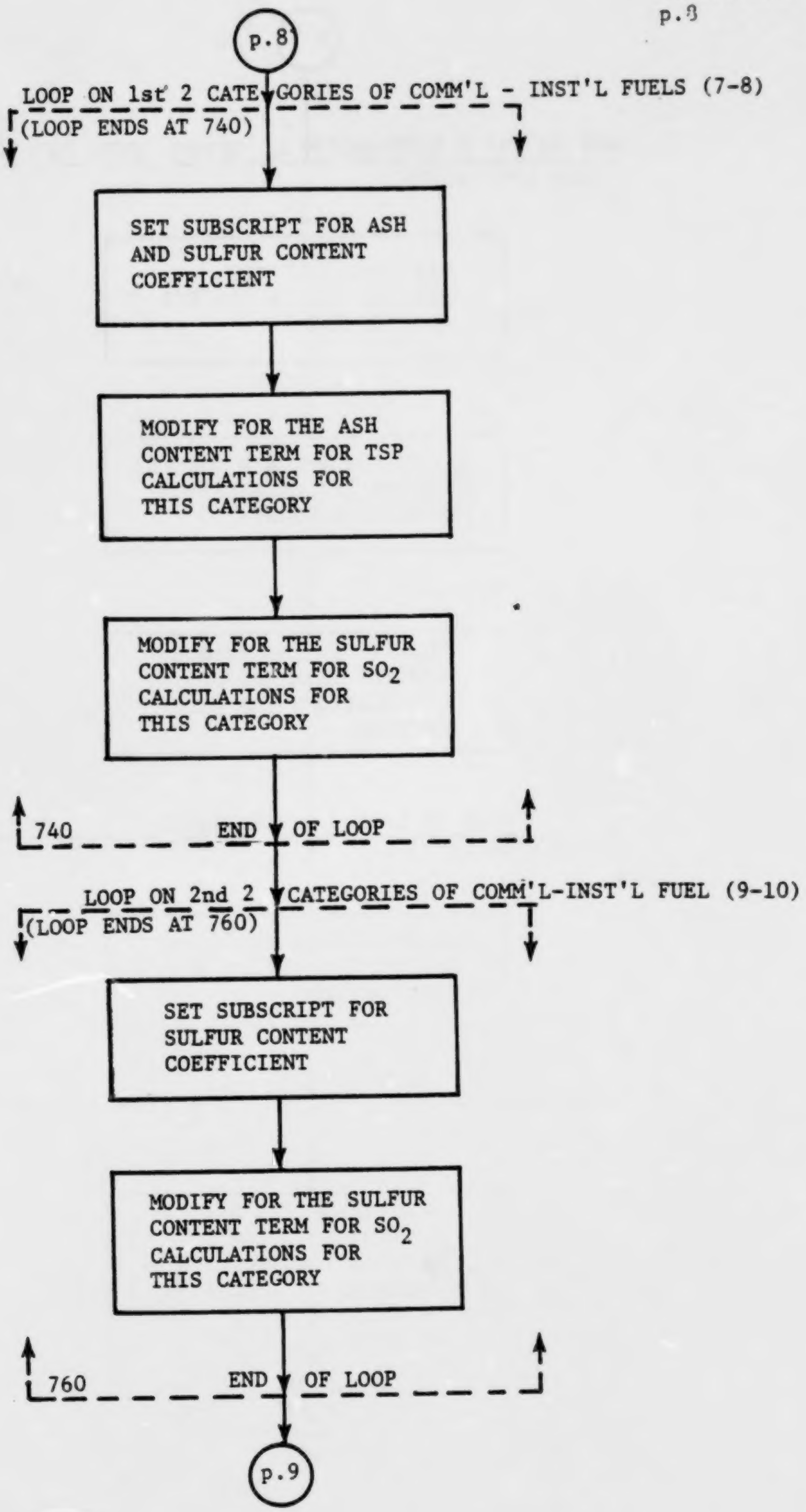

p.4
STATE AND COUNTY OF INTEREST HAVE BEEN FOUND BACK-SPACE 1 RECORD.
LOOP ON DIMENSIONS SET IN DRIVER
(LOOP ENDS AT 480)
CAASE4 OUTPUT TAPE
READ IN WEIGHTED APPORTIONING FACTORS
HAS AN END-OF-FILE BEEN ENCOUNTERED
YES
D p.5
NO
HAS ANOTHER STATE OR COUNTY BEEN ENCOUNTERED
YES
B p.5
NO
480
END OF LOOP
DIMENSIONS WERE NOT ADEQUATE PRINT ERROR MESSAGE STATING SAME
Z p.22

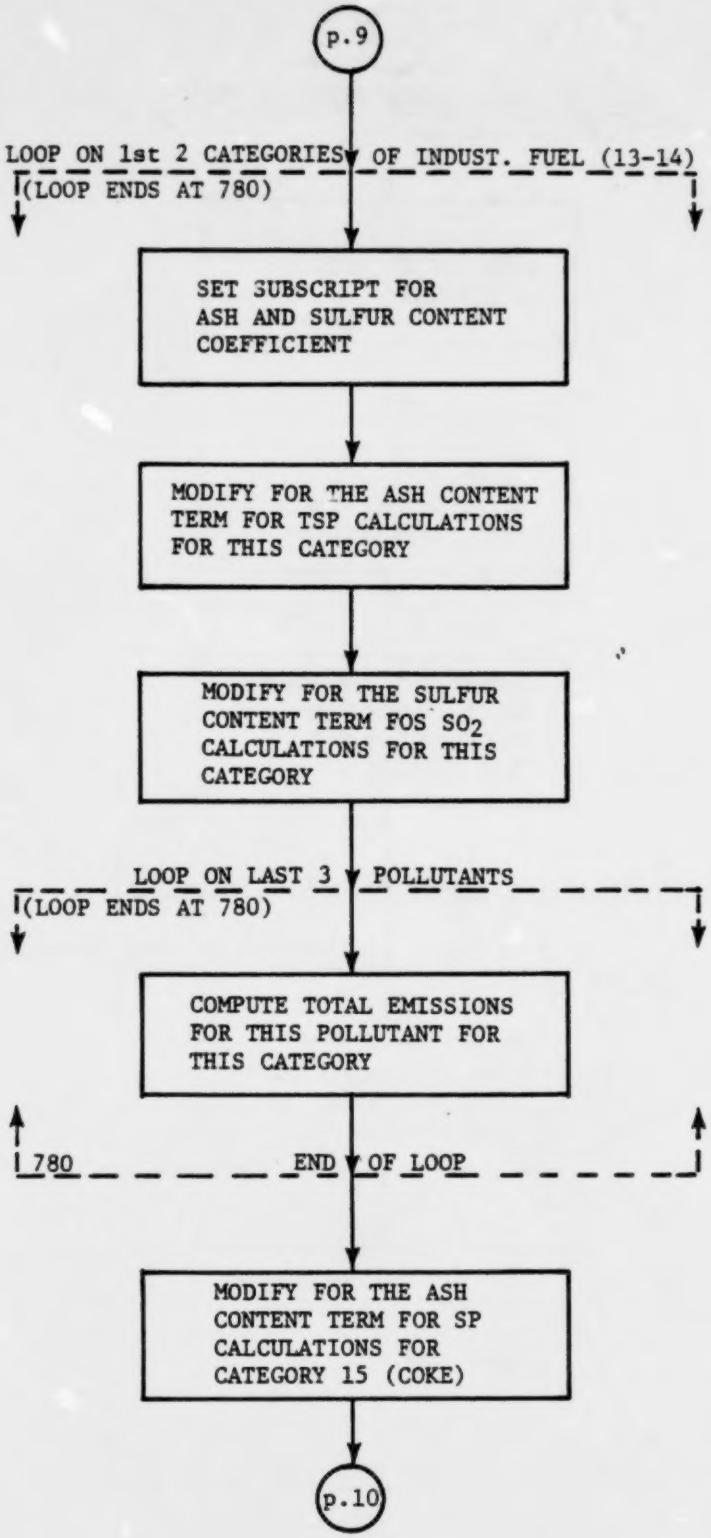

B
BACKSPACE INPUT TAPE ONE RECORD
D
460
SET TOTAL GRID SQUARES VARIABLE
520
CONTINUE
LOOP ON 56 CATEGORIES
(LOOP ENDS AT 560)
INITIALIZE APPORTIONING TOTAL ARRAY TO ZERO FOR CATEGORY OF INTEREST
LOOP ON NUMBER OF GRID SQUARES THIS COUNTY
(LOOP ENDS AT 540)
CALCULATE APPORTIONING FACTOR SUMS OF THIS CATEGORY FOR THIS GRID SQUARE
540 END OF LOOP
560 END OF LOOP
p.6

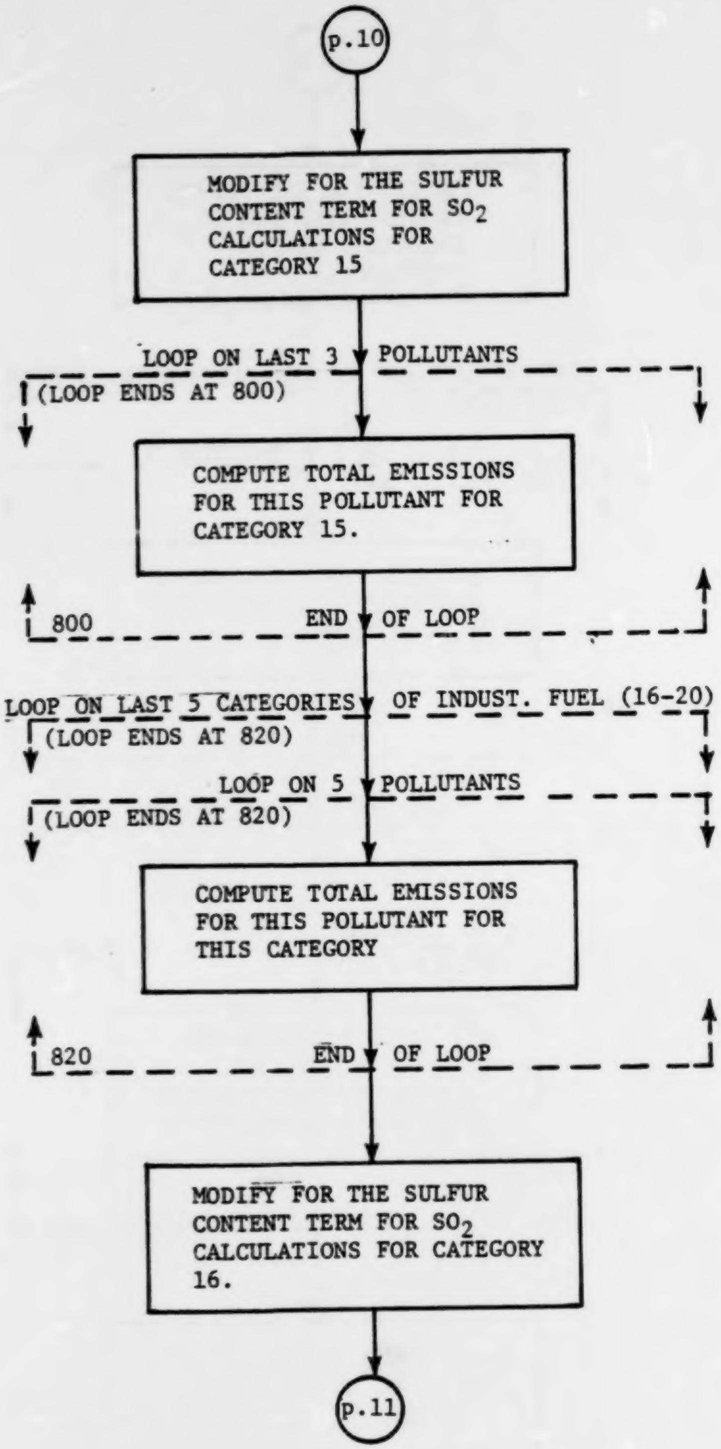

p.6
LOOP ON 56 CATEGORIES
(LOOP ENDS AT 600)
LOOP ON NUMBER OF GRID SQUARES THIS COUNTY
(LOOP ENDS AT 600)
DOES APPORTIONING TOTAL FOR THIS CATEGORY EQUAL ZERO
YES
NO
APPORTION FUEL FOR THIS CATEGORY AND AREA SOURCE GRID SQUARE
580
SET APPORTIONED FUEL FOR THIS CATEGORY AND AREA SOURCE GRID SQUARE TO ZERO
600 END OF LOOP
CALL SUBROUTINE OUTPT1 TO FORMAT OUTPUT FOR APPORTIONED FUELS THROUGHPUT
p.7

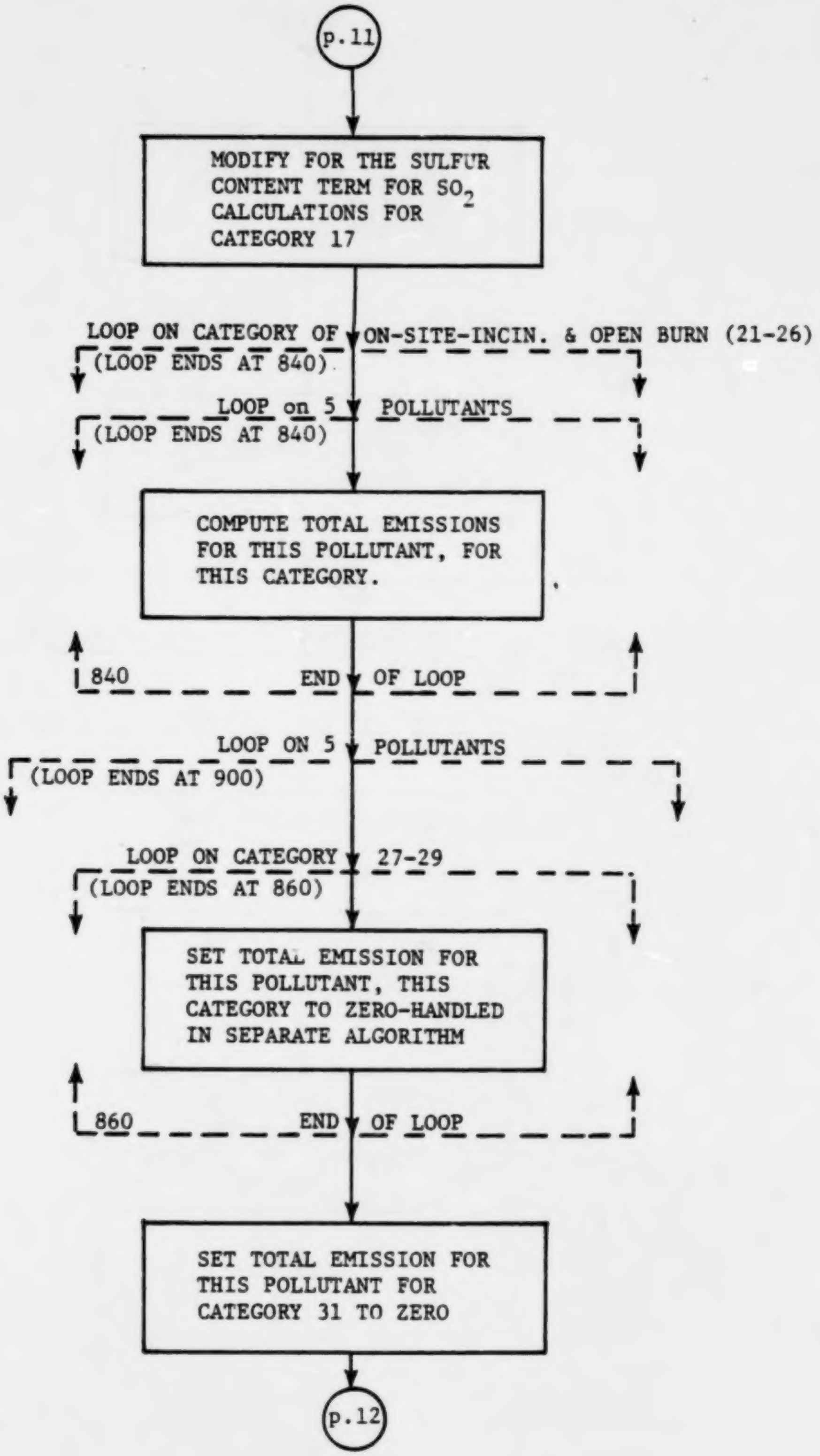
CAASE5
SUBROUTINE CAASE5
p.7

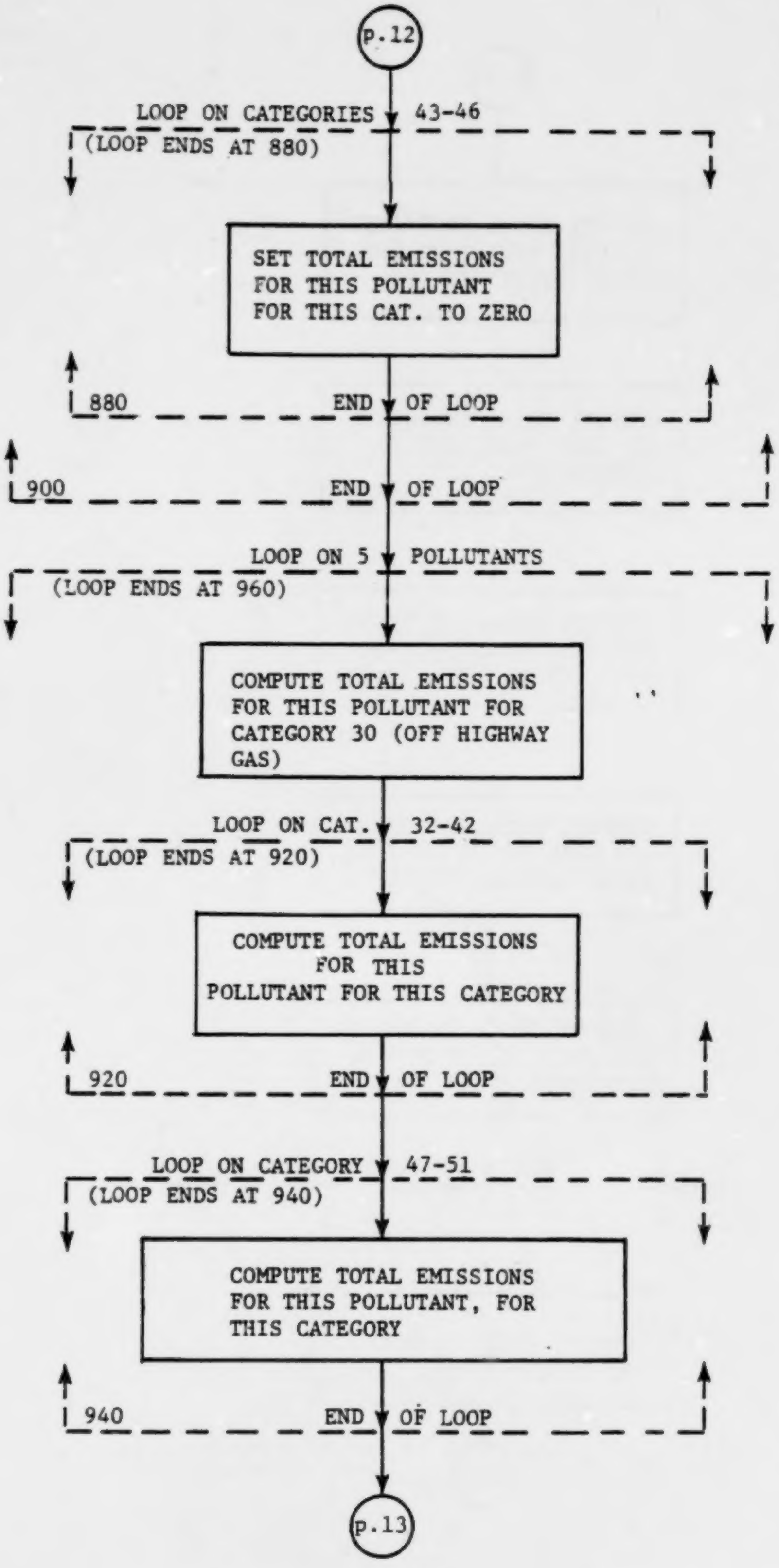

p.7
LOOP ON 5 POLLUTANTS
(LOOP ENDS AT 680)
LOOP ON 1st 6 CATEGORIES OF RESIDENTIAL FUEL
(LOOP ENDS AT 680)
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT FOR THIS CATEGORY
680 END OF LOOP
LOOP ON 1st 4 CATEGORIES OF RESIDENTIAL FUEL
(LOOP ENDS AT 700)
MODIFY FOR THE SULFUR CONTENT TERM OF SO2 CALCULATIONS FOR THIS CATEGORY
700 END OF LOOP
LOOP ON 5 POLLUTANTS
(LOOP ENDS AT 720)
LOOP ON 6 CATEGORIES OF COMM'L & INST'L FUEL (7-12)
(LOOP ENDS AT 720)
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT, FOR THIS CATEGORY
720 END OF LOOP
p.8

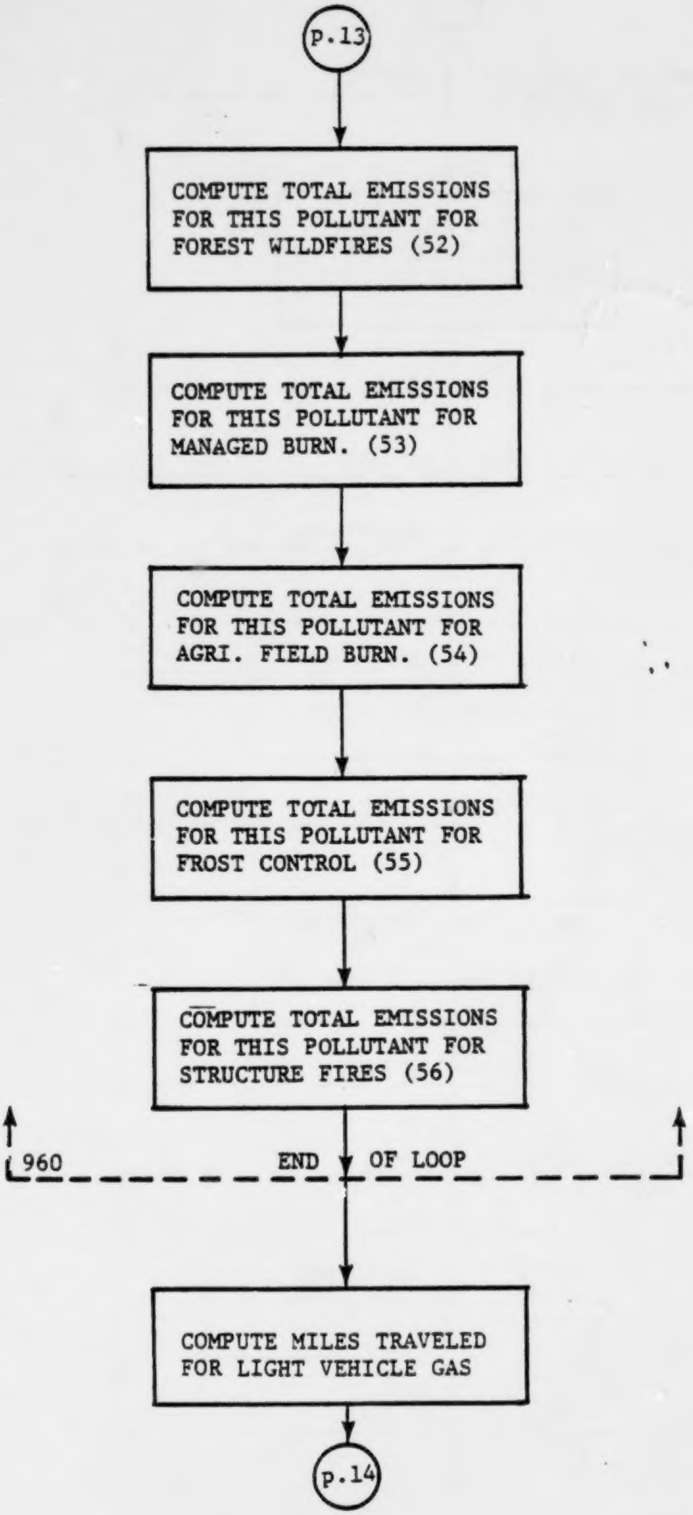

p.8
LOOP ON 1st 2 CATEGORIES OF COMM'L - INST'L FUELS (7-8)
(LOOP ENDS AT 740)
SET SUBSCRIPT FOR ASH AND SULFUR CONTENT COEFFICIENT
MODIFY FOR THE ASH CONTENT TERM FOR TSP CALCULATIONS FOR THIS CATEGORY
MODIFY FOR THE SULFUR CONTENT TERM FOR SO2 CALCULATIONS FOR THIS CATEGORY
740
END OF LOOP
LOOP ON 2nd 2 CATEGORIES OF COMM'L-INST'L FUEL (9-10)
(LOOP ENDS AT 760)
SET SUBSCRIPT FOR SULFUR CONTENT COEFFICIENT
MODIFY FOR THE SULFUR CONTENT TERM FOR SO2 CALCULATIONS FOR THIS CATEGORY
760
END OF LOOP
p.9

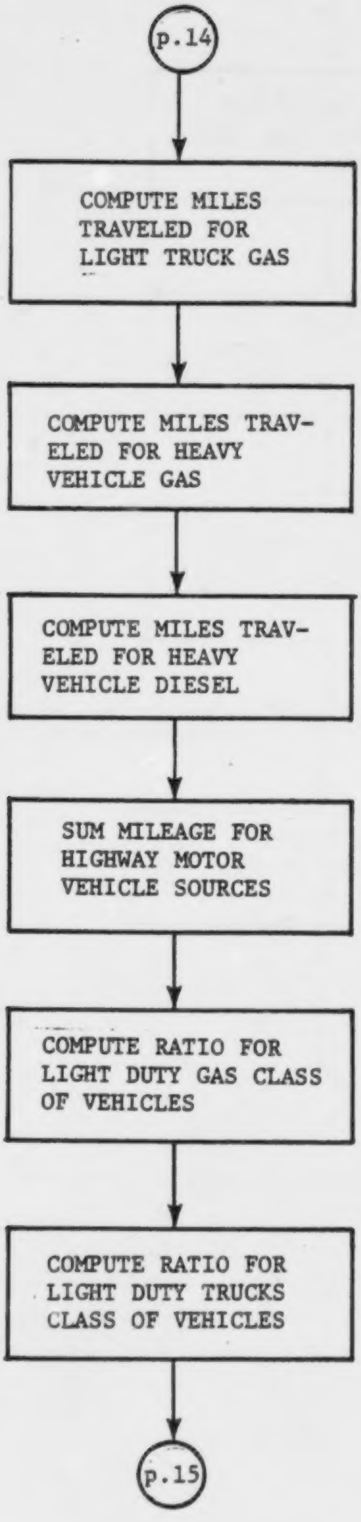

p.9
LOOP ON 1st 2 CATEGORIES OF INDUST. FUEL (13-14)
(LOOP ENDS AT 780)
SET SUBSCRIPT FOR ASH AND SULFUR CONTENT COEFFICIENT
MODIFY FOR THE ASH CONTENT TERM FOR TSP CALCULATIONS FOR THIS CATEGORY
MODIFY FOR THE SULFUR CONTENT TERM FOS SO_2 CALCULATIONS FOR THIS CATEGORY
LOOP ON LAST 3 POLLUTANTS
(LOOP ENDS AT 780)
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT FOR THIS CATEGORY
780
END OF LOOP
MODIFY FOR THE ASH CONTENT TERM FOR SP CALCULATIONS FOR CATEGORY 15 (COKE)
p.10

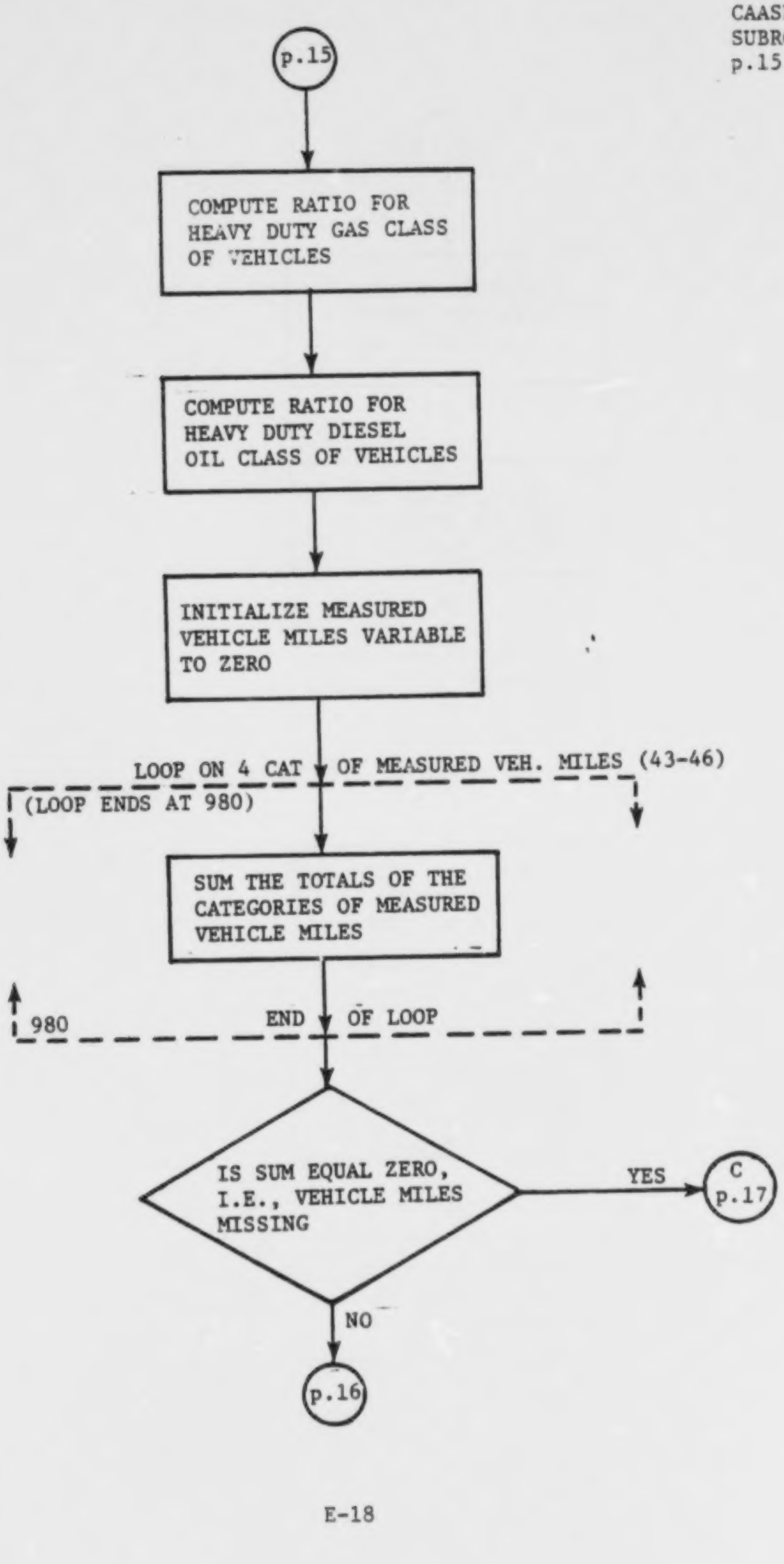

p.10
MODIFY FOR THE SULFUR CONTENT TERM FOR SO_2 CALCULATIONS FOR CATEGORY 15
LOOP ON LAST 3 POLLUTANTS
(LOOP ENDS AT 800)
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT FOR CATEGORY 15.
800
END OF LOOP
LOOP ON LAST 5 CATEGORIES OF INDUST. FUEL (16-20)
(LOOP ENDS AT 820)
LOOP ON 5 POLLUTANTS
(LOOP ENDS AT 820)
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT FOR THIS CATEGORY
820
END OF LOOP
MODIFY FOR THE SULFUR CONTENT TERM FOR SO_2 CALCULATIONS FOR CATEGORY 16.
p.11

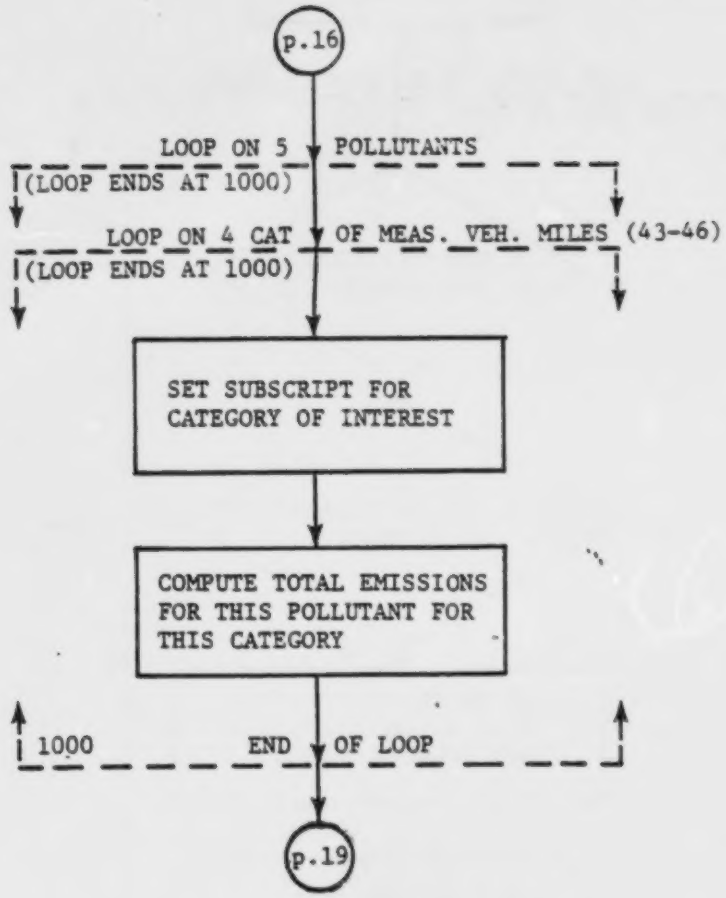

p.11
MODIFY FOR THE SULFUR CONTENT TERM FOR SO_2 CALCULATIONS FOR CATEGORY 17
LOOP ON CATEGORY OF ON-SITE-INCIN. & OPEN BURN (21-26)
(LOOP ENDS AT 840)
LOOP on 5 POLLUTANTS
(LOOP ENDS AT 840)
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT, FOR THIS CATEGORY.
840 END OF LOOP
LOOP ON 5 POLLUTANTS
(LOOP ENDS AT 900)
LOOP ON CATEGORY 27-29
(LOOP ENDS AT 860)
SET TOTAL EMISSION FOR THIS POLLUTANT, THIS CATEGORY TO ZERO-HANDLED IN SEPARATE ALGORITHM
860 END OF LOOP
SET TOTAL EMISSION FOR THIS POLLUTANT FOR CATEGORY 31 TO ZERO
p.12

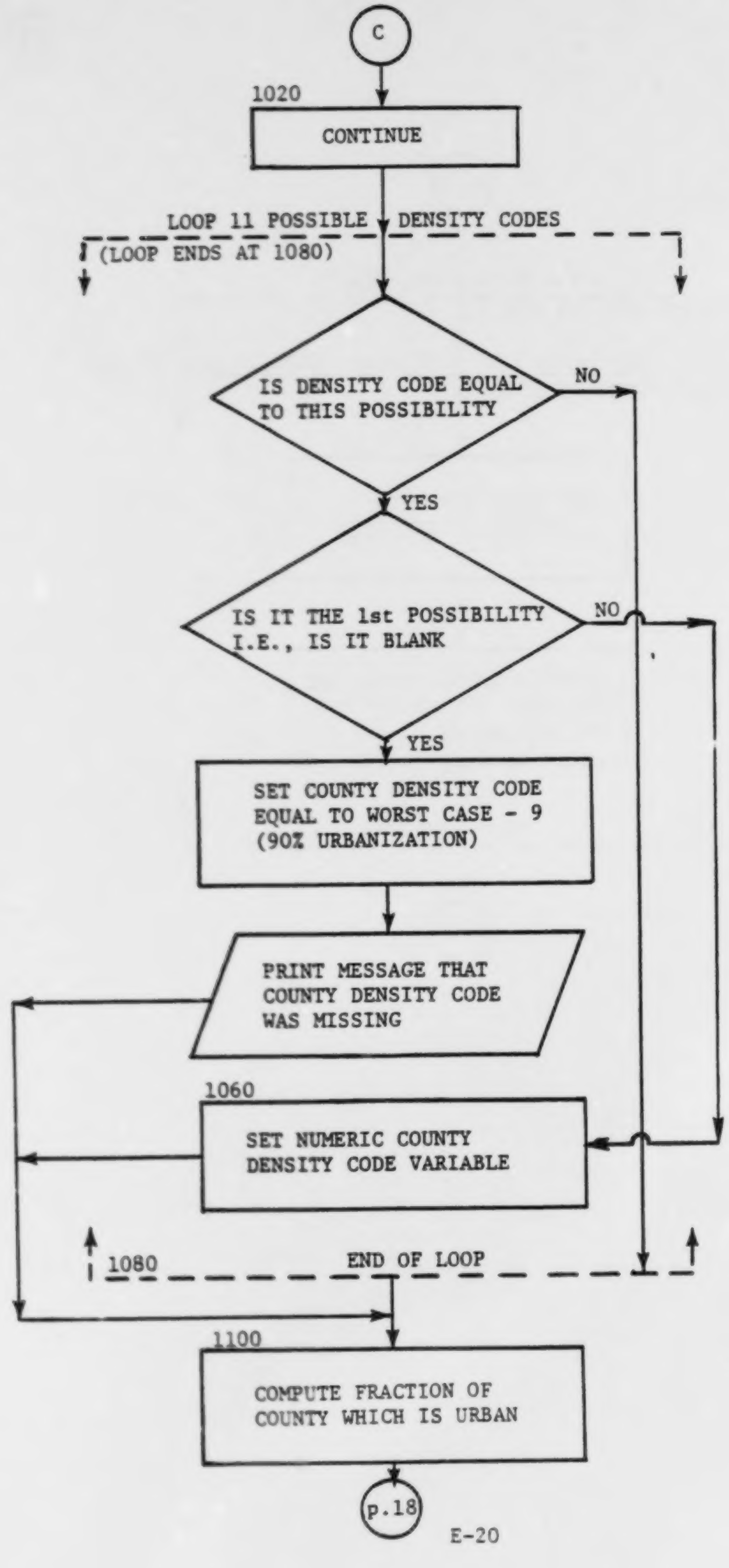

p.12
LOOP ON CATEGORIES 43-46
(LOOP ENDS AT 880)
SET TOTAL EMISSIONS FOR THIS POLLUTANT FOR THIS CAT. TO ZERO
880 END OF LOOP
900 END OF LOOP
LOOP ON 5 POLLUTANTS
(LOOP ENDS AT 960)
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT FOR CATEGORY 30 (OFF HIGHWAY GAS)
LOOP ON CAT. 32-42
(LOOP ENDS AT 920)
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT FOR THIS CATEGORY
920 END OF LOOP
LOOP ON CATEGORY 47-51
(LOOP ENDS AT 940)
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT, FOR THIS CATEGORY
940 END OF LOOP
p.13

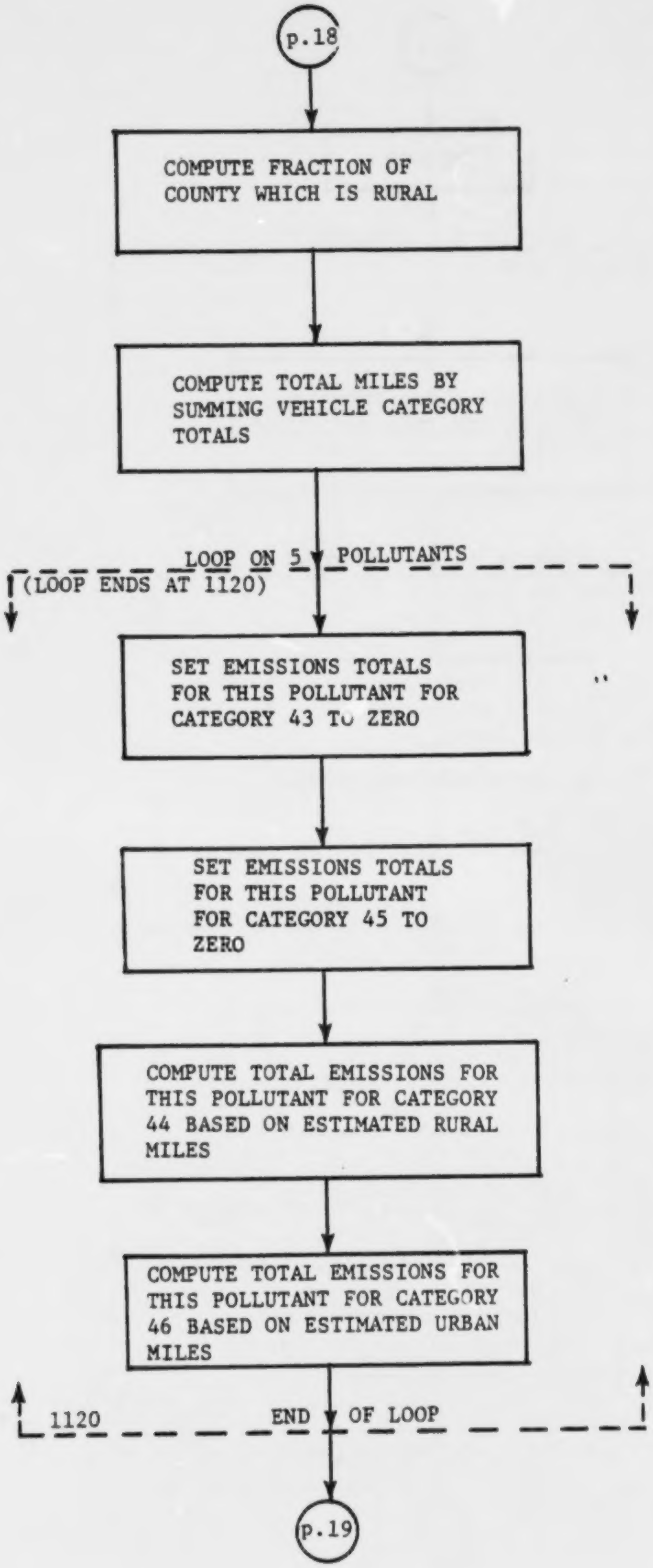

p.13
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT FOR FOREST WILDFIRES (52)
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT FOR MANAGED BURN. (53)
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT FOR AGRI. FIELD BURN. (54)
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT FOR FROST CONTROL (55)
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT FOR STRUCTURE FIRES (56)
960
END OF LOOP
COMPUTE MILES TRAVELED FOR LIGHT VEHICLE GAS
p.14

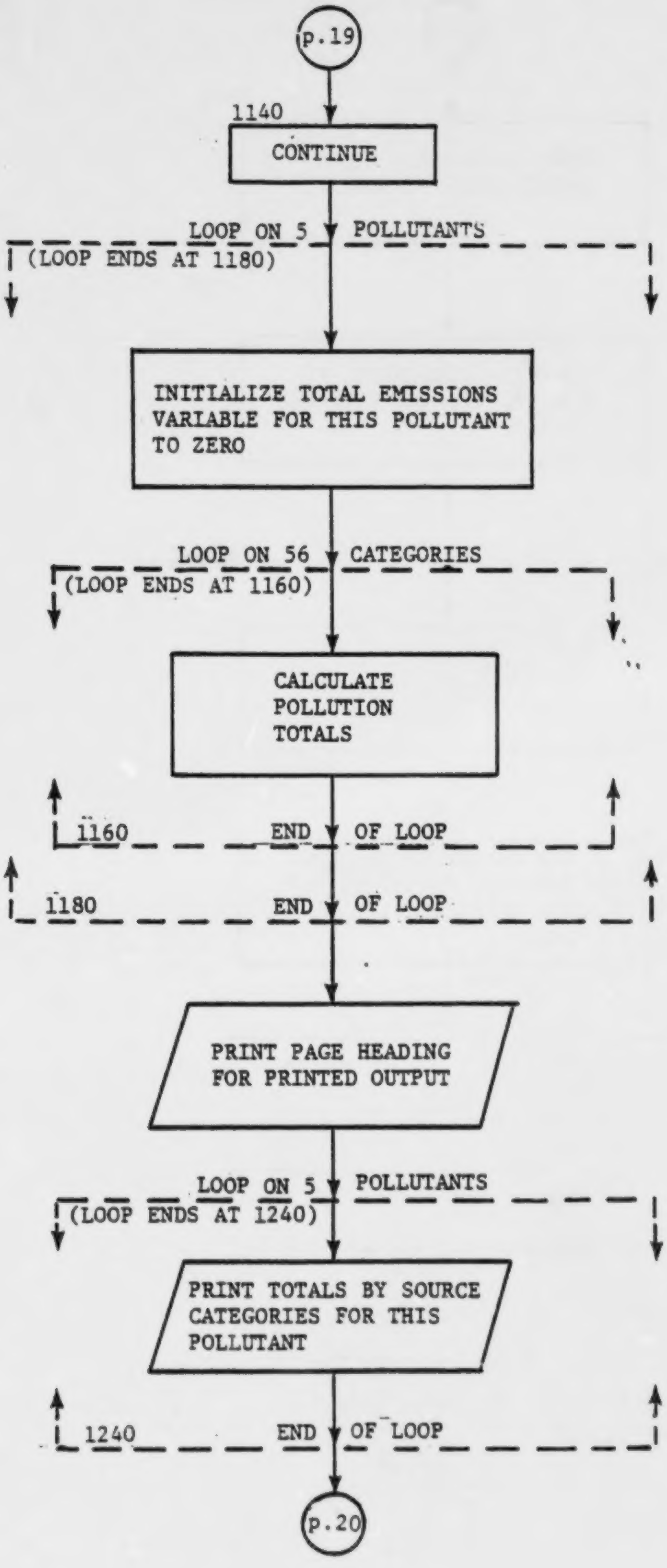

p.14
COMPUTE MILES TRAVELED FOR LIGHT TRUCK GAS
COMPUTE MILES TRAVELED FOR HEAVY VEHICLE GAS
COMPUTE MILES TRAVELED FOR HEAVY VEHICLE DIESEL
SUM MILEAGE FOR HIGHWAY MOTOR VEHICLE SOURCES
COMPUTE RATIO FOR LIGHT DUTY GAS CLASS OF VEHICLES
COMPUTE RATIO FOR LIGHT DUTY TRUCKS CLASS OF VEHICLES
p.15

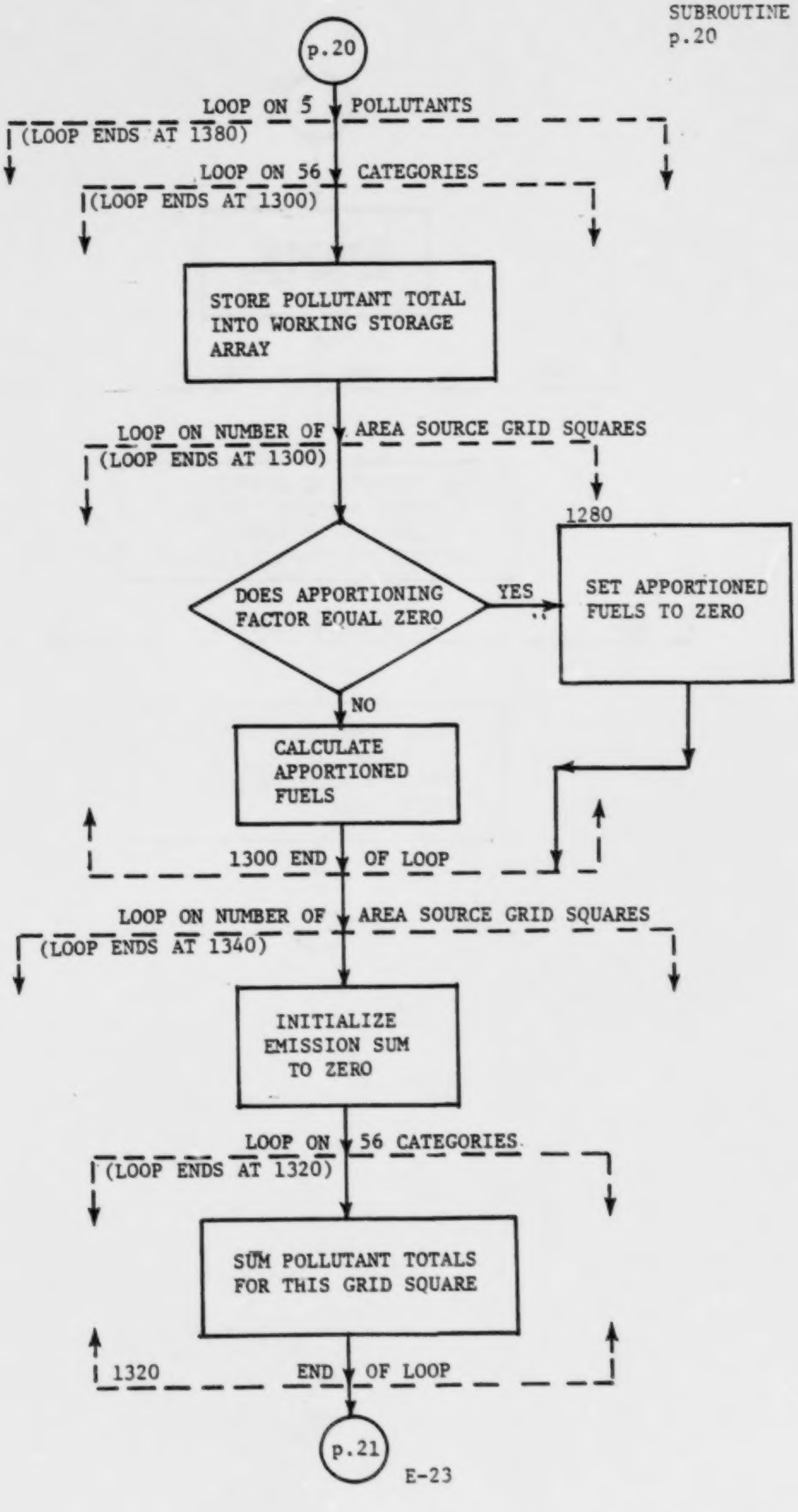

p.15
COMPUTE RATIO FOR HEAVY DUTY GAS CLASS OF VEHICLES
COMPUTE RATIO FOR HEAVY DUTY DIESEL OIL CLASS OF VEHICLES
INITIALIZE MEASURED VEHICLE MILES VARIABLE TO ZERO
LOOP ON 4 CAT OF MEASURED VEH. MILES (43-46)
(LOOP ENDS AT 980)
SUM THE TOTALS OF THE CATEGORIES OF MEASURED VEHICLE MILES
980
END OF LOOP
IS SUM EQUAL ZERO, I.E., VEHICLE MILES MISSING
YES
C
p.17
NO
p.16

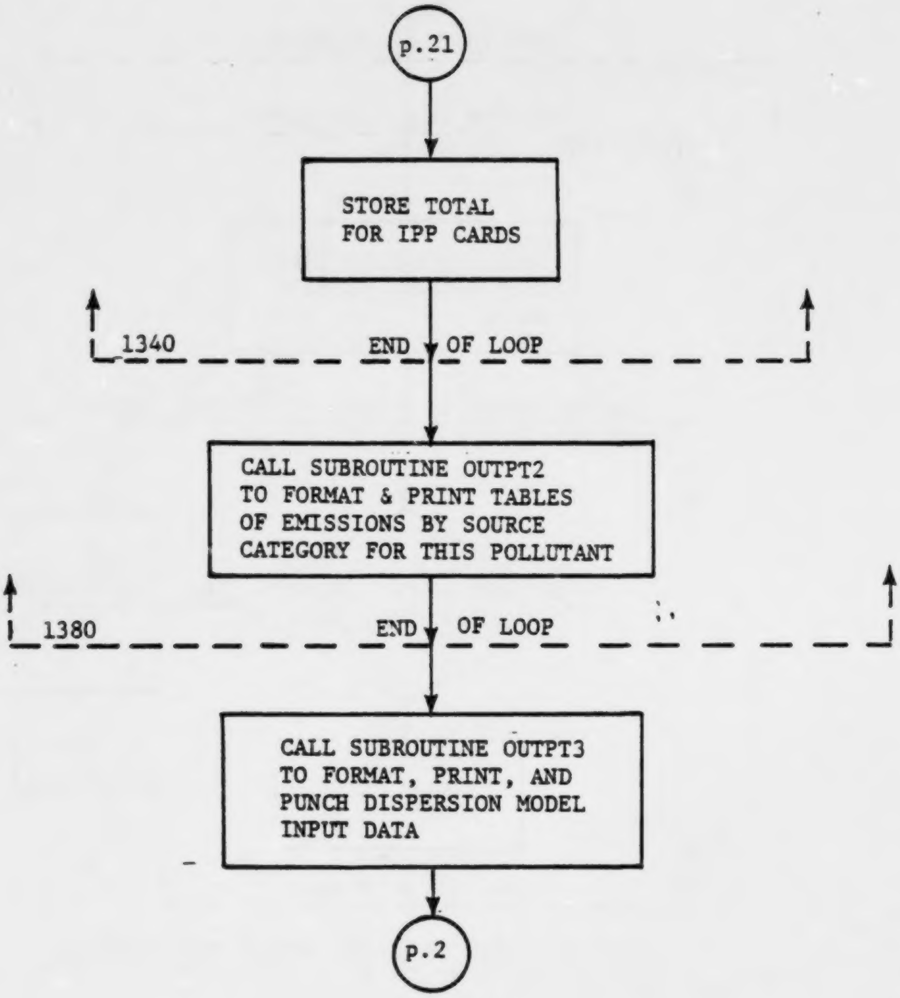

p.16
LOOP ON 5 POLLUTANTS
(LOOP ENDS AT 1000)
LOOP ON 4 CAT OF MEAS. VEH. MILES (43-46)
(LOOP ENDS AT 1000)
SET SUBSCRIPT FOR CATEGORY OF INTEREST
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT FOR THIS CATEGORY
1000 END OF LOOP
p.19

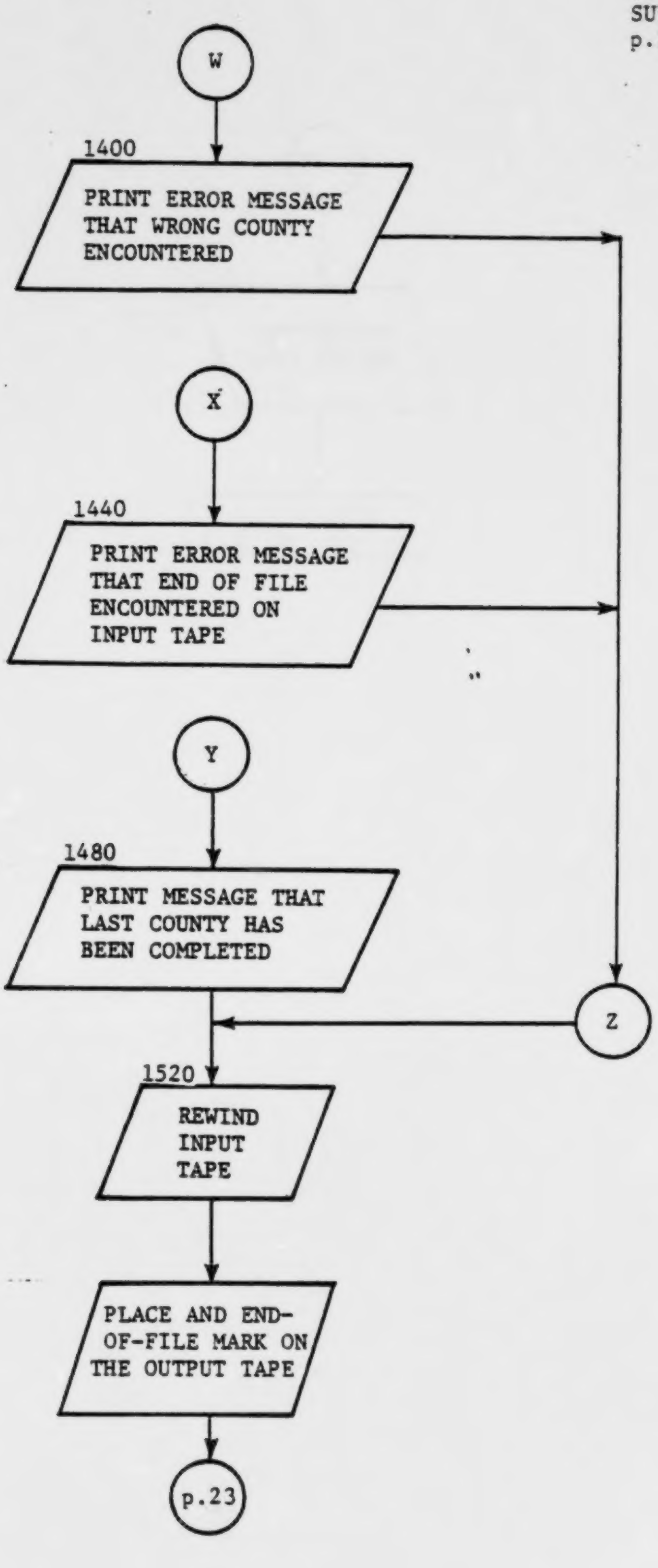

C
1020
CONTINUE
LOOP 11 POSSIBLE DENSITY CODES
(LOOP ENDS AT 1080)
IS DENSITY CODE EQUAL TO THIS POSSIBILITY
NO
YES
IS IT THE 1st POSSIBILITY I.E., IS IT BLANK
NO
YES
SET COUNTY DENSITY CODE EQUAL TO WORST CASE - 9 (90% URBANIZATION)
PRINT MESSAGE THAT COUNTY DENSITY CODE WAS MISSING
1060
SET NUMERIC COUNTY DENSITY CODE VARIABLE
1080
END OF LOOP
1100
COMPUTE FRACTION OF COUNTY WHICH IS URBAN
p.18

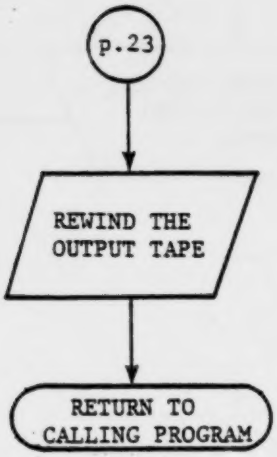

p.18
COMPUTE FRACTION OF COUNTY WHICH IS RURAL
COMPUTE TOTAL MILES BY SUMMING VEHICLE CATEGORY TOTALS
LOOP ON 5 POLLUTANTS
(LOOP ENDS AT 1120)
SET EMISSIONS TOTALS FOR THIS POLLUTANT FOR CATEGORY 43 TO ZERO
SET EMISSIONS TOTALS FOR THIS POLLUTANT FOR CATEGORY 45 TO ZERO
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT FOR CATEGORY 44 BASED ON ESTIMATED RURAL MILES
COMPUTE TOTAL EMISSIONS FOR THIS POLLUTANT FOR CATEGORY 46 BASED ON ESTIMATED URBAN MILES
1120
END OF LOOP
p.19

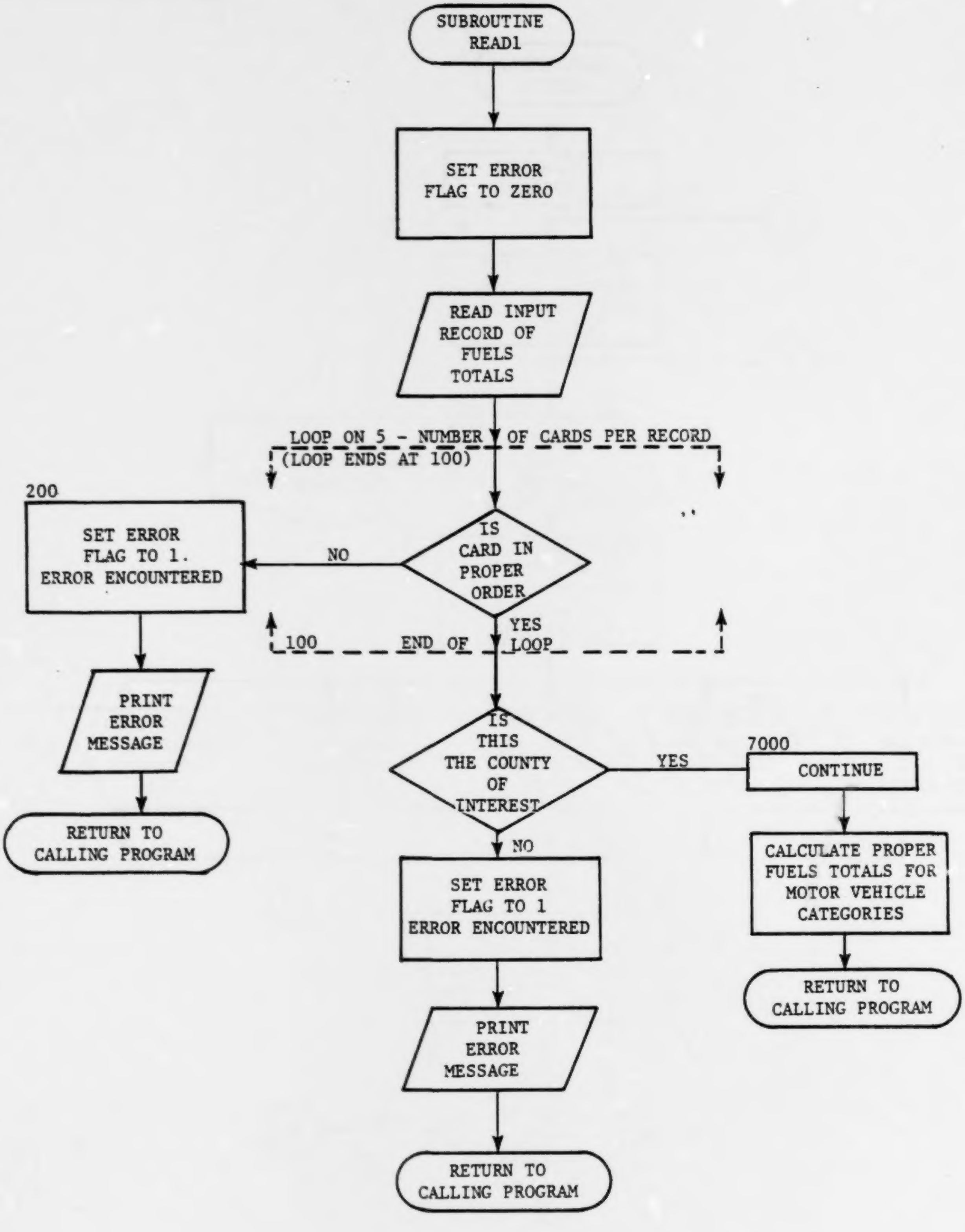

p.19
1140
CONTINUE
LOOP ON 5 POLLUTANTS
(LOOP ENDS AT 1180)
INITIALIZE TOTAL EMISSIONS VARIABLE FOR THIS POLLUTANT TO ZERO
LOOP ON 56 CATEGORIES
(LOOP ENDS AT 1160)
CALCULATE POLLUTION TOTALS
1160 END OF LOOP
1180 END OF LOOP
PRINT PAGE HEADING FOR PRINTED OUTPUT
LOOP ON 5 POLLUTANTS
(LOOP ENDS AT 1240)
PRINT TOTALS BY SOURCE CATEGORIES FOR THIS POLLUTANT
1240 END OF LOOP
p.20

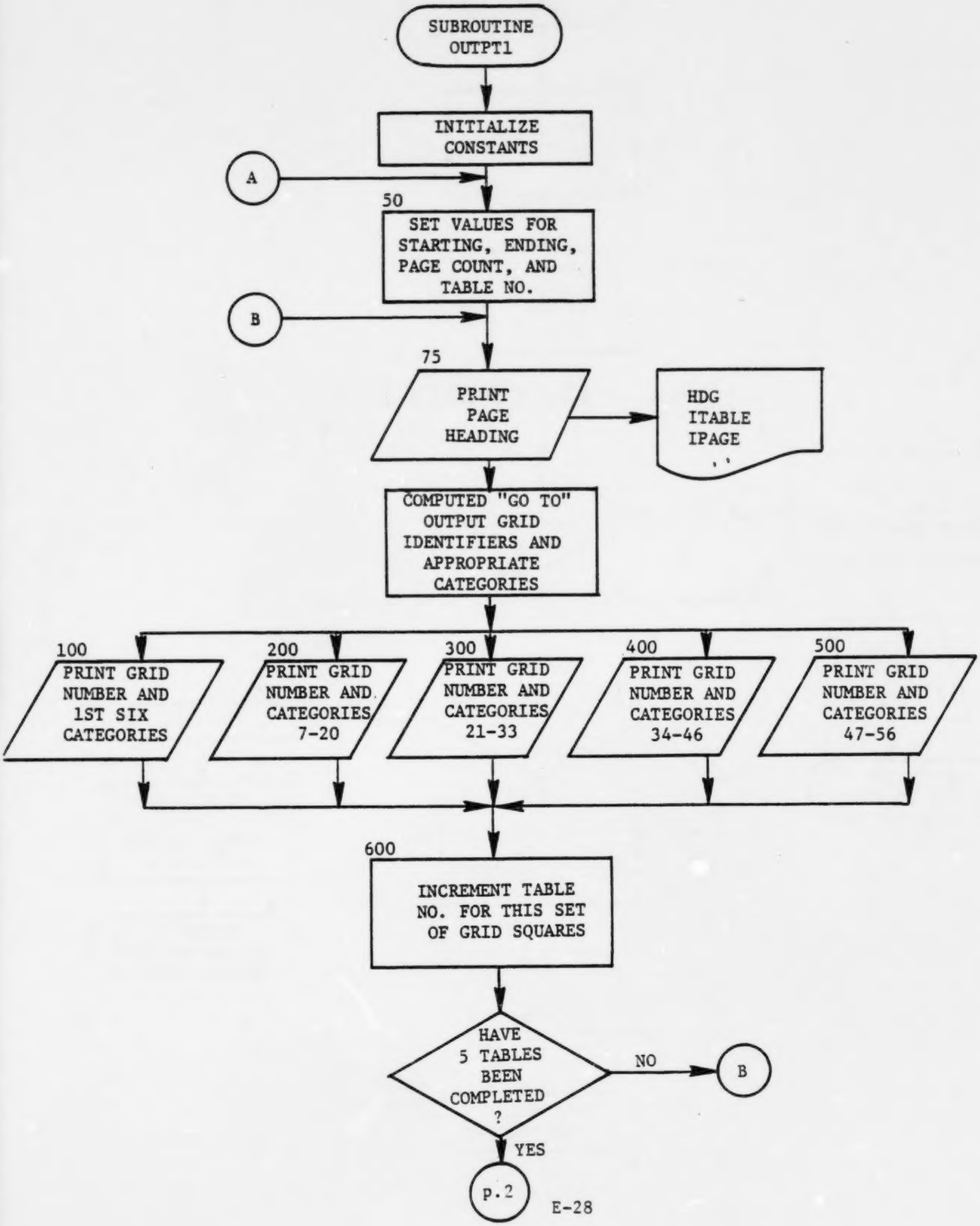

p.20
LOOP ON 5 POLLUTANTS
(LOOP ENDS AT 1380)
LOOP ON 56 CATEGORIES
(LOOP ENDS AT 1300)
STORE POLLUTANT TOTAL INTO WORKING STORAGE ARRAY
LOOP ON NUMBER OF AREA SOURCE GRID SQUARES
(LOOP ENDS AT 1300)
DOES APPORTIONING FACTOR EQUAL ZERO
YES
1280
SET APPORTIONED FUELS TO ZERO
NO
CALCULATE APPORTIONED FUELS
1300 END OF LOOP
LOOP ON NUMBER OF AREA SOURCE GRID SQUARES
(LOOP ENDS AT 1340)
INITIALIZE EMISSION SUM TO ZERO
LOOP ON 56 CATEGORIES
(LOOP ENDS AT 1320)
SUM POLLUTANT TOTALS FOR THIS GRID SQUARE
1320 END OF LOOP
p.21

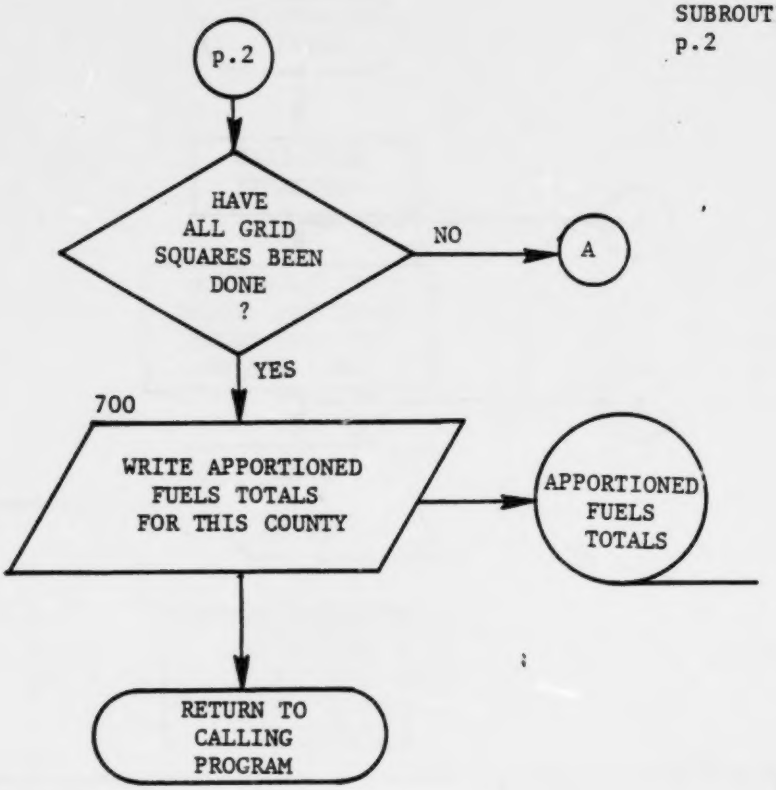

p.21
STORE TOTAL FOR IPP CARDS
1340
END OF LOOP
CALL SUBROUTINE OUTPT2 TO FORMAT & PRINT TABLES OF EMISSIONS BY SOURCE CATEGORY FOR THIS POLLUTANT
1380
END OF LOOP
CALL SUBROUTINE OUTPT3 TO FORMAT, PRINT, AND PUNCH DISPERSION MODEL INPUT DATA
p.2

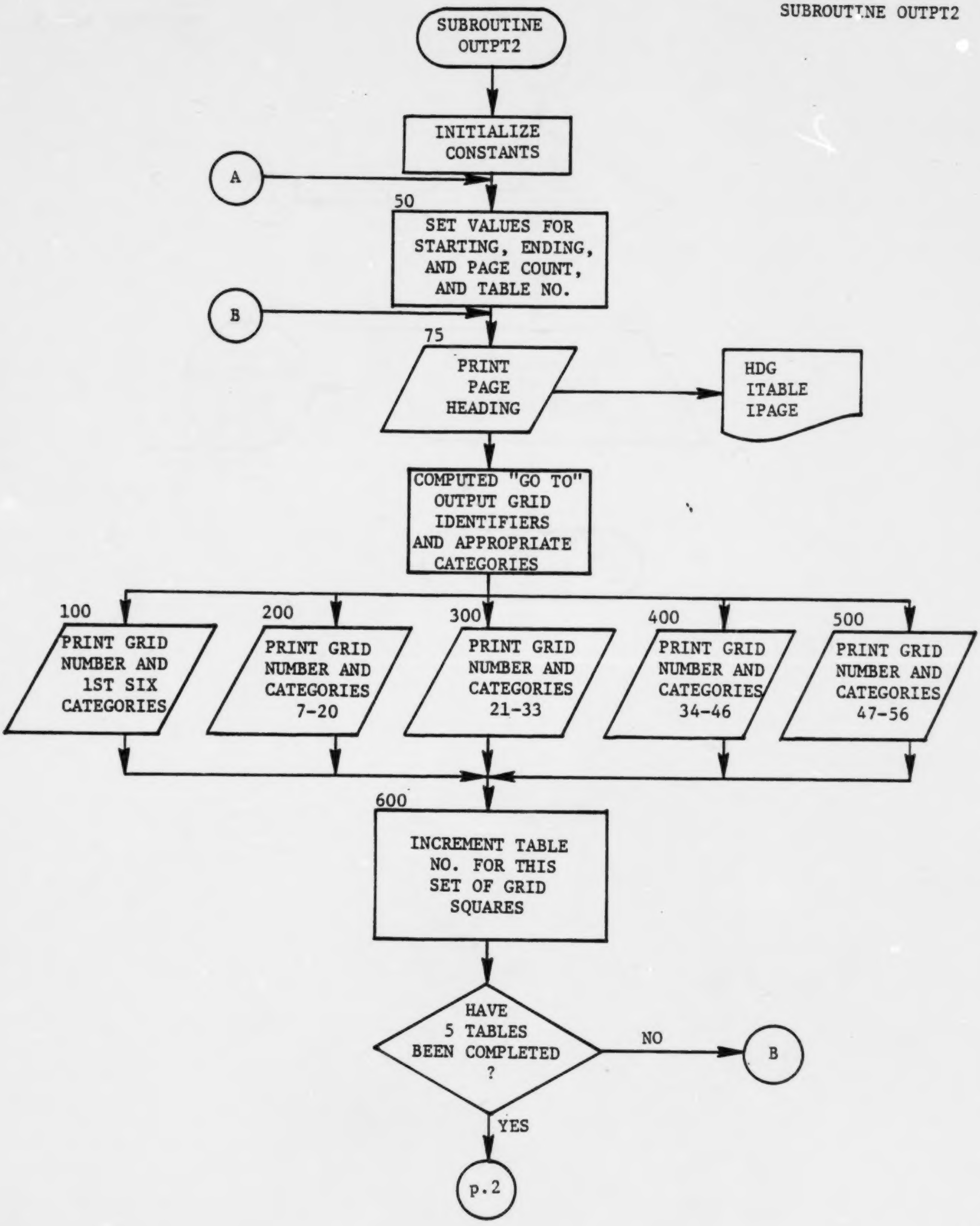

W
1400
PRINT ERROR MESSAGE THAT WRONG COUNTY ENCOUNTERED
X
1440
PRINT ERROR MESSAGE THAT END OF FILE ENCOUNTERED ON INPUT TAPE
Y
1480
PRINT MESSAGE THAT LAST COUNTY HAS BEEN COMPLETED
Z
1520
REWIND INPUT TAPE
PLACE AND END-OF-FILE MARK ON THE OUTPUT TAPE
p.23


p.23
REWIND THE OUTPUT TAPE
RETURN TO CALLING PROGRAM

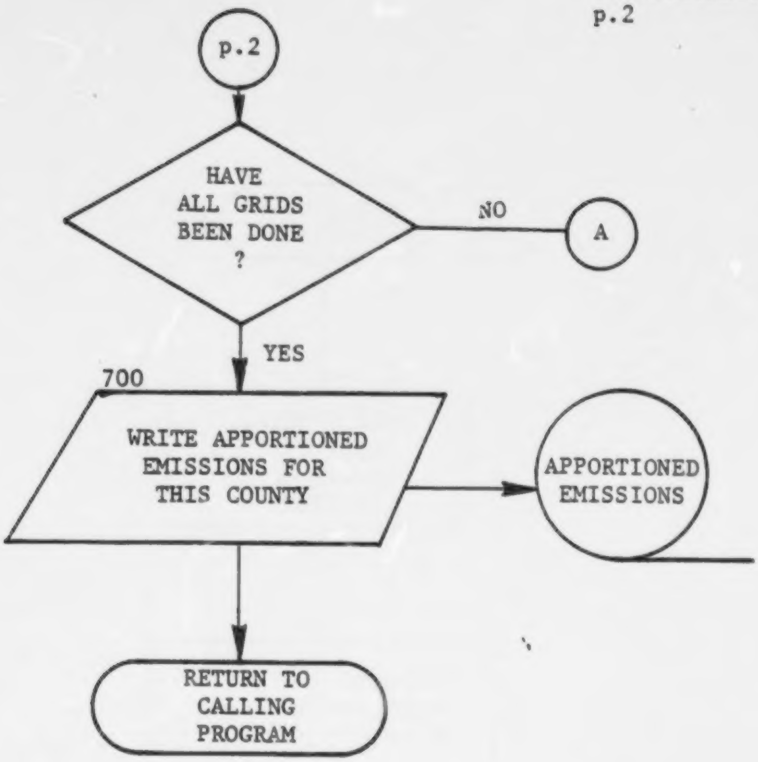

SUBROUTINE READ1
SET ERROR FLAG TO ZERO
READ INPUT RECORD OF FUELS TOTALS
LOOP ON 5 - NUMBER OF CARDS PER RECORD
(LOOP ENDS AT 100)
200
SET ERROR FLAG TO 1. ERROR ENCOUNTERED
NO
IS CARD IN PROPER ORDER
YES
100 END OF LOOP
PRINT ERROR MESSAGE
RETURN TO CALLING PROGRAM
IS THIS THE COUNTY OF INTEREST
YES
7000
CONTINUE
NO
SET ERROR FLAG TO 1 ERROR ENCOUNTERED
CALCULATE PROPER FUELS TOTALS FOR MOTOR VEHICLE CATEGORIES
RETURN TO CALLING PROGRAM
PRINT ERROR MESSAGE
RETURN TO CALLING PROGRAM

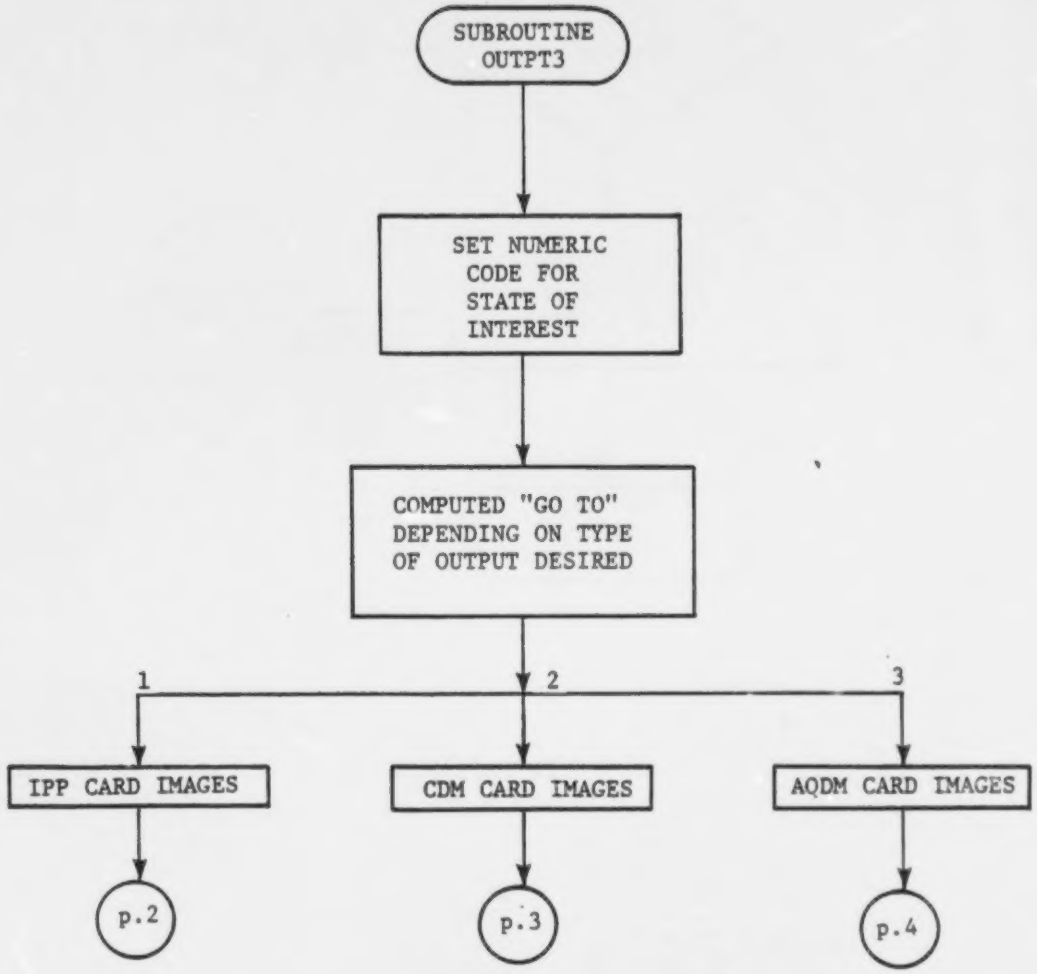

SUBROUTINE OUTPT1
INITIALIZE CONSTANTS
A
50
SET VALUES FOR STARTING, ENDING, PAGE COUNT, AND TABLE NO.
B
75
PRINT PAGE HEADING
HDG
ITABLE
IPAGE
COMPUTED "GO TO" OUTPUT GRID IDENTIFIERS AND APPROPRIATE CATEGORIES
100
PRINT GRID NUMBER AND 1ST SIX CATEGORIES
200
PRINT GRID NUMBER AND CATEGORIES 7-20
300
PRINT GRID NUMBER AND CATEGORIES 21-33
400
PRINT GRID NUMBER AND CATEGORIES 34-46
500
PRINT GRID NUMBER AND CATEGORIES 47-56
600
INCREMENT TABLE NO. FOR THIS SET OF GRID SQUARES
HAVE 5 TABLES BEEN COMPLETED ?
NO
B
YES
p.2

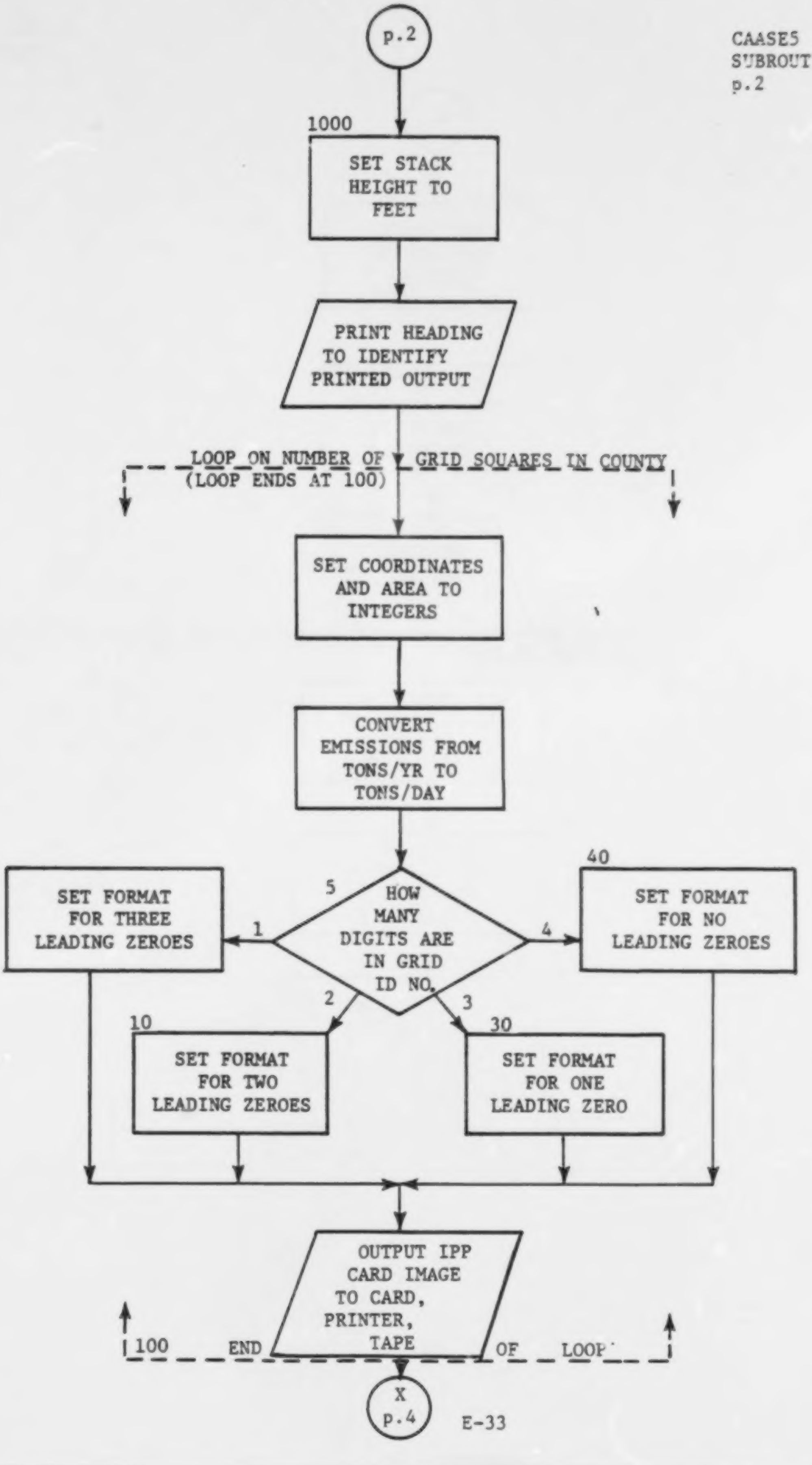

p.2
HAVE ALL GRID SQUARES BEEN DONE ?
NO
A
YES
700
WRITE APPORTIONED FUELS TOTALS FOR THIS COUNTY
APPORTIONED FUELS TOTALS
RETURN TO CALLING PROGRAM

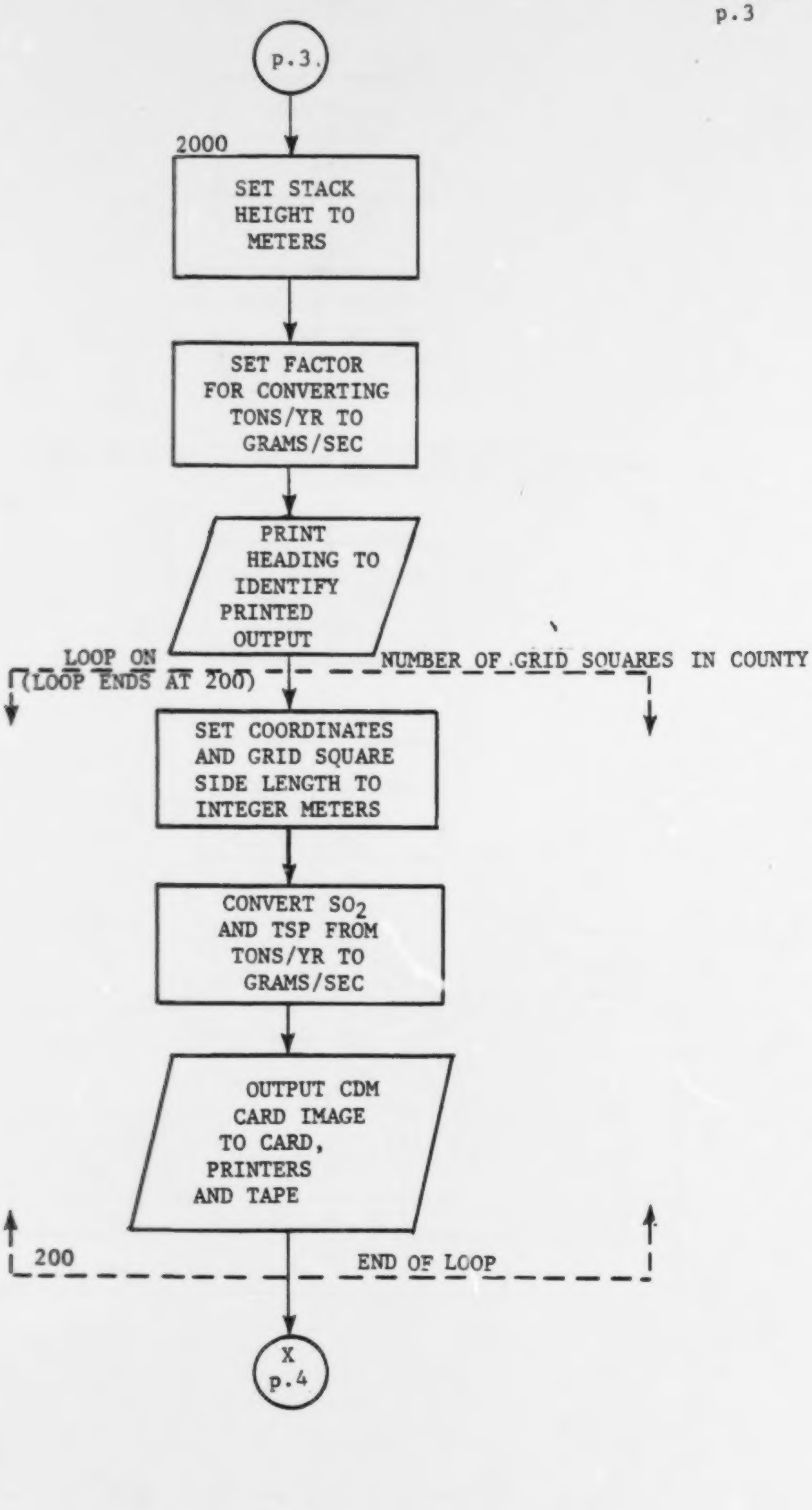

SUBROUTINE OUTPT2
INITIALIZE CONSTANTS
A
50
SET VALUES FOR STARTING, ENDING, AND PAGE COUNT, AND TABLE NO.
B
75
PRINT PAGE HEADING
HDG ITABLE IPAGE
COMPUTED "GO TO" OUTPUT GRID IDENTIFIERS AND APPROPRIATE CATEGORIES
100
PRINT GRID NUMBER AND 1ST SIX CATEGORIES
200
PRINT GRID NUMBER AND CATEGORIES 7-20
300
PRINT GRID NUMBER AND CATEGORIES 21-33
400
PRINT GRID NUMBER AND CATEGORIES 34-46
500
PRINT GRID NUMBER AND CATEGORIES 47-56
600
INCREMENT TABLE NO. FOR THIS SET OF GRID SQUARES
HAVE 5 TABLES BEEN COMPLETED ?
NO
B
YES
p.2

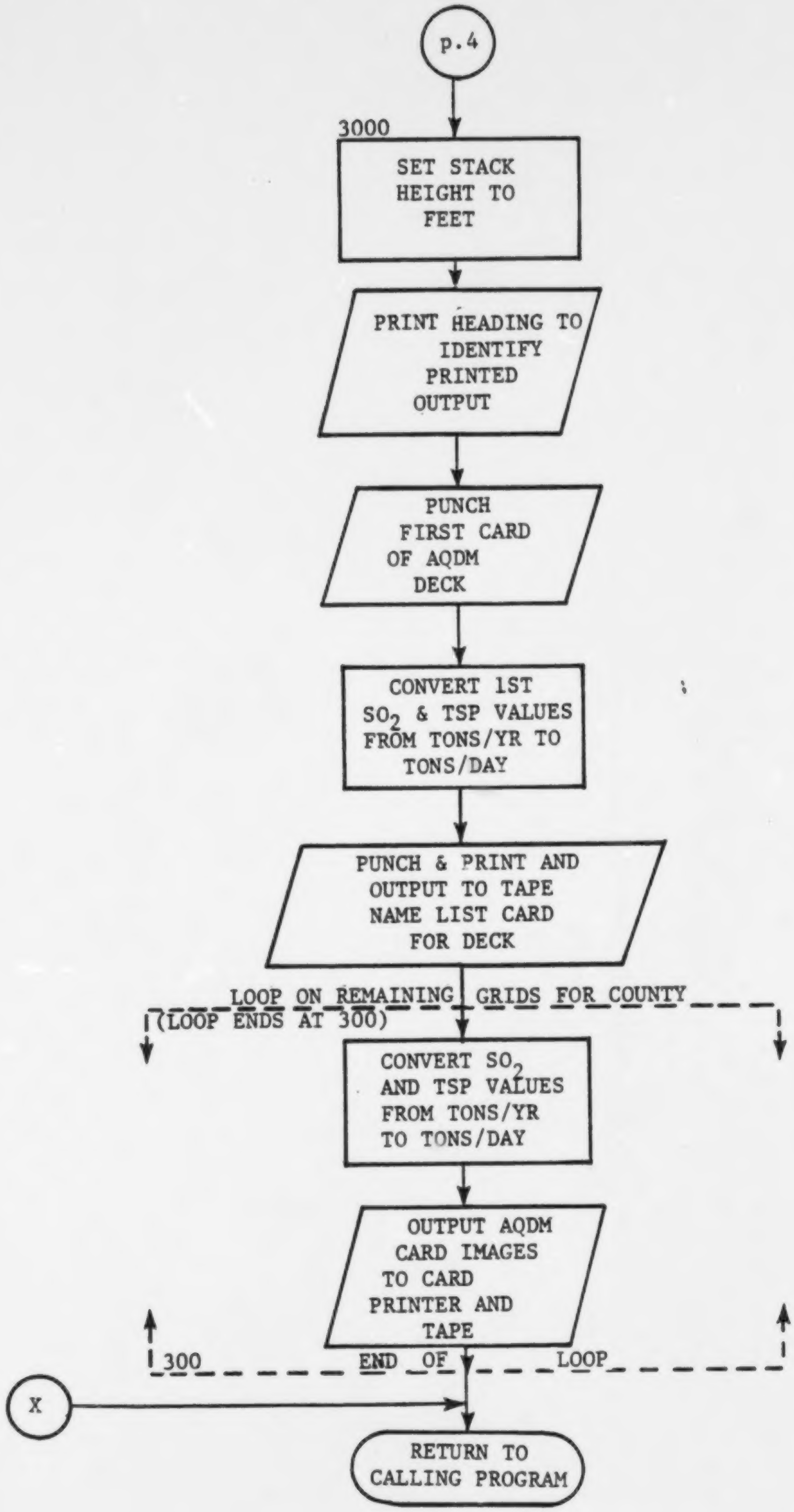
CAASE5
SUBROUTINE OUTPT2
p.2


p.2
HAVE ALL GRIDS BEEN DONE ?
NO
A
YES
700
WRITE APPORTIONED EMISSIONS FOR THIS COUNTY
APPORTIONED EMISSIONS
RETURN TO CALLING PROGRAM


SUBROUTINE OUTPT3
SET NUMERIC CODE FOR STATE OF INTEREST
COMPUTED "GO TO" DEPENDING ON TYPE OF OUTPUT DESIRED
1
2
3
IPP CARD IMAGES
CDM CARD IMAGES
AQDM CARD IMAGES
p.2
p.3
p.4


p.2
1000
SET STACK HEIGHT TO FEET
PRINT HEADING TO IDENTIFY PRINTED OUTPUT
LOOP ON NUMBER OF GRID SQUARES IN COUNTY
(LOOP ENDS AT 100)
SET COORDINATES AND AREA TO INTEGERS
CONVERT EMISSIONS FROM TONS/YR TO TONS/DAY
5
HOW MANY DIGITS ARE IN GRID ID NO.
1
SET FORMAT FOR THREE LEADING ZEROES
4
40
SET FORMAT FOR NO LEADING ZEROES
2
10
SET FORMAT FOR TWO LEADING ZEROES
3
30
SET FORMAT FOR ONE LEADING ZERO
OUTPUT IPP CARD IMAGE TO CARD, PRINTER, TAPE
100 END OF LOOP
X
p.4


p.3
2000
SET STACK HEIGHT TO METERS
SET FACTOR FOR CONVERTING TONS/YR TO GRAMS/SEC
PRINT HEADING TO IDENTIFY PRINTED OUTPUT
LOOP ON NUMBER OF GRID SQUARES IN COUNTY
(LOOP ENDS AT 200)
SET COORDINATES AND GRID SQUARE SIDE LENGTH TO INTEGER METERS
CONVERT SO2 AND TSP FROM TONS/YR TO GRAMS/SEC
OUTPUT CDM CARD IMAGE TO CARD, PRINTERS AND TAPE
200
END OF LOOP
X
p.4


p.4
3000
SET STACK HEIGHT TO FEET
PRINT HEADING TO IDENTIFY PRINTED OUTPUT
PUNCH FIRST CARD OF AQDM DECK
CONVERT 1ST SO2 & TSP VALUES FROM TONS/YR TO TONS/DAY
PUNCH & PRINT AND OUTPUT TO TAPE NAME LIST CARD FOR DECK
LOOP ON REMAINING GRIDS FOR COUNTY
(LOOP ENDS AT 300)
CONVERT SO2 AND TSP VALUES FROM TONS/YR TO TONS/DAY
OUTPUT AQDM CARD IMAGES TO CARD PRINTER AND TAPE
300
END OF LOOP
X
RETURN TO CALLING PROGRAM

```
C****PROGRAM NAME: CAASES
C
C   DRIVER FOR CAASES TO SET DIMENSIONS
C   MUST BE RECOMPILED ANYTIME IT IS NECESSARY TO CHANGE THE DIMENSIONS
C
      DIMENSION APPORT(56,61),OUTIPP(61,5),ID(61),X(61),Y(61),
     1AREA(61),APFUEL(56,61)
C
C*** NDIM IS THE NUMBER OF GRID SQUARES IN A COUNTY -- IT SHOULD
C   BE SET DEPENDENT ON THE COUNTY (BEING PROCESSED DURING A
C   COMPUTER RUN) WITH THE LARGEST NUMBER OF GRID SQUARES.
C
      NDIM = 60
      CALL CAASES (APPORT,OUTIPP,APFUEL,ID,X,Y,AREA,NDIM)
      CALL EXIT
      END
```

Reproduced from best available copy.

```
      SUBROUTINE CAASE5(APPORT,OUTIPP,APFUEL,ID,X,Y,AREA,NDIM)
C
C***CAASE5 USES THE APPORTIONING FACTORS DEVELOPED BY CAASE4 FOR THE
C  GRID SQUARES DEVELOPED IN CAASE2 AND THE FUELS/THROUGHPUT FOR EACH
C  AREA SOURCE INPUT FORM (EPA(DUR)219) FOR EACH COUNTY IN THE STUDY
C  AREA.  EMISSION FACTORS FOR EACH SOURCE CATEGORY ARE READ FOR EACH OF
C  THE PRIMARY POLLUTANTS (TSP,SO2,NOX,HC,CO).  FUELS/THROUGHPUT ARE
C  APPORTIONED TO EACH GRID SQUARE FOR EACH SOURCE CATEGORY.  APPLYING
C  EMISSION FACTORS, EMISSIONS ARE CALCULATED FOR EACH SOURCE CATEGORY
C  POLLUTANT AND THEN APPORTIONED TO EACH GRID SQUARE ON A COUNTY BY
C  COUNTY BASIS.  TABLES ARE PRINTED AND THE USER HAS THE OPTION OF
C  PRODUCING AREA SOURCE FORMATTED INPUT CARDS FOR ANY ONE OF THE THREE
C  DISPERSION MODELS--AQDM, IPP, OR CDM.  EMISSION FACTORS ARE READ IN
C  FOR EACH POLLUTANT/SOURCE CATEGORY COMBINATION.  EXCEPT IN THE CASE
C  OF HIGHWAY MOTOR VEHICLE SOURCE EMISSION FACTORS, THE FACTORS ARE
C  SCALED AND UNITS ARE CONVERTED OFF-LINE, I.E, IF THE EMISSION FACTOR
C  FOR EXAMPLE, IS 20 POUNDS OF TSP PRODUCED FOR EACH TON OF BITUMINOUS
C  COAL BURNED FOR HOME HEATING AND THE TOTAL TONS BURNED IS EXPRESSED
C  IN TENS OF TONS ON THE NEDS AREA SOURCE FORM, THEN THE FACTOR READ
C  IN IS 0.10 (10 SCALING TIMES 20 LBS PER TON BURNED DIVIDED BY 2000
C  LBS PER TON) AND THE PROGRAM MULTIPLIES THE FUEL REPORTED ON THE FORM
C  BY THE 0.10 FACTOR YIELDING EMISSIONS IN TONS.  FOR THOSE SOURCE
C  CATEGORY/POLLUTANT COMBINATIONS WHERE PERCENT ASH OR SULFUR CONTENT
C  IS USED, THE PROGRAM AUTOMATICALLY APPLIES THEM DURING THE ON-LINE
C***CALLULATION.
C
C**** DATA STATEMENT FOR LABELS FOR EACH POLLUTANT TABLE IS INCLUDED IN
C      OUTPUT ROUTINE
C      DIMENSIONS ASSUME NDIM IS MAX NUMBER OF GRIDS PER COUNTY
C
      DIMENSION TOES(11)
      REAL*8 RLD,RLDT,RHDG,RHDD,VLGTG,TLGTG,VHVYG,VHVYD,SUMM,TOTMI,CONVH
      REAL*8 PD,PR
      DATA TOES/'    ','0   ','1   ','2   ','3   ','4   ','5   ','6   ',
     1'7   ','8   ','9   '/
      DIMENSION APPORT(56,NDIM),APTOT(56),OUTIPP(NDIM,5),EMFACT(56,5),AP
     1FUEL(56,NDIM)
```

```
C
C     APFUEL ARRAY CONTAINS APPORTIONED FUELS EARLY IN THE PROGRAM AND
C     LATER CONTAINS APPORTIONED EMMISIONS FOR EACH OF THE FIVE PRIMARY
C     POLLUTANTS IN TURN.
C
      COMMON /WHICH/XSTATE,ICNTY,XAQCR,CNTY,NAREAS,HDR(20),IPOLIT,IREGN
      COMMON /FUELS/KSTATE,KOUNTY,AQCR,YR,SC(4),AC(2),FLTOTS(56),CTYDEN,
     1TONSFW,TONSMB,TONSAF,DAYSF
      COMMON /IOUNIT/IREADR,ITAPET,ITAPEN,ITAPEO,IPUNCH,IPRINT,IERR
      DIMENSION X(NDIM),Y(NDIM),AREA(NDIM),ID(NDIM)
      COMMON /TOTPOL/POLTOT(56,5)
C**** STRUCTURE IS VEHICLE CLASS,ROAD TYPE, POLLUTANT
      DIMENSION EFHV(4,4,5),POLHDG(5)
      DIMENSION SUMKK(5)
      DATA POLHDG/' SP ','SO2 ','NOX ',' HC ',' CO '/
      DIMENSION EMFAC1(56),EMFAC2(56),EMFAC3(56),EMFAC4(56),EMFAC5(56)
      EQUIVALENCE (EMFAC1(1),EMFACT(1,1)),(EMFAC2(1),EMFACT(1,2)),(EMFAC
     13(1),EMFACT(1,3)),(EMFAC4(1),EMFACT(1,4)),(EMFAC5(1),EMFACT(1,5))
C
C**** ASSIGN I/O UNIT NUMBERS
C
      IREADR=1
C
C*** ITAPEN = APPORTIONING VALUES FOR EACH SOURCE CATEGORY/GRID SQUARE
C    COMBINATION (FROM CAASE4)
C
      ITAPEN=6
C
C**** ITAPEO = OUTPUT OF APPORTIONED FUELS, APPORTIONED EMISSIONS AND
C     DISPERSION MODEL INPUT DATA.
C
      ITAPEO=5
C
C**** PUNCH
C
      IPUNCH=2
C
```

```
C****PRINTER
C
      IPRINT=3
      NDIMP1=NDIM+1
C
C**** CONSTANT TO USE WITH HIGHWAY MOTOR VEHICLE ALGORITHM
C
C***10000 MILES PER UNIT DIVIDED BY 453.6 GRAMS/POUND AND
C                 CONVERT TO TONS
C
      CONVEH=5.0/4.536D2
C
C**** READ IN THE EMISSION FACTOR TABLES FOR THE 5 POLLUTANTS
C      AND THE HIGHWAY MOTOR VEHICLE SOURCE CATEGORIES
C      ORDER IS THE SAME AS ON NEDS AREA SOURCE FORM WHERE ZEROES ARE
C   USED AS FILLERS FOR HIGHWAY MOTOR VEHICLE CATEGORIES AND MEASURED
C   VEHICLE MILES CATEGORIES.
C
C
C****  TSP
C
      READ (IREADR,100) EMFAC1
C
C***** SO2
C
      READ (IREADR,100) EMFAC2
C
C***** NOX
C
      READ (IREADR,100) EMFAC3
C
C***** HC
C
      READ (IREADR,100) EMFAC4
C
C***** CO
C
```

```
      READ (IREADR,100) EMFACS
C
C   THE FOLLOWING ARRAY CONTAINS EMISSION FACTORS IN GRAMS PER VEHICLE
C   MILE TRAVELLED (VMT) BASED ON VEHICLE CLASS AND ROAD CLASS.  THESE
C    ARE READ FROM CARDS IN THE FOLLOWING ORDER (I,J,K)
C                              I = 1,4   (VEHICLE CLASS),
C                              J = 1,4   (ROAD TYPE),
C                              K = 1,5   (POLLUTANT)
C
      READ (IREADR,100) EFHV
  100 FORMAT (8F10.0)
C
C**** IWANT -- SUBROUTINE OUTPT3 OUTPUT CHOICE
C                1 -- IPP INPUT CARDS OR
C                2 -- CDM INPUT CARDS OR
C                3 -- AQDM INPUT CARDS
C
      READ (IREADR,120) IWANT
  120 FORMAT (I5)
C
C     READ IN STATE AND COUNTY OF INTEREST , NUMERIC STUDY AREA, TOTAL
C    NUMBER OF GRID SQUARES, IN THE COUNTY, POLITICAL SUBDIVISION (TO
C    INCLUDE ON IPP CARDS) AND ALPHANUMERIC REGION NUMBER.
C
C
C***** SEE USERS MANUAL FOR DEFINITION OF THESE VARIABLES
C
  140 READ (IREADR,160) XSTATE,ICNTY,XAQCR,NAREAS,CNTY,KOUNTY,KSTATE,IPO
     1LIT,IREGN
  160 FORMAT (F10.0,I10,F10.0,I10,6X,A4,2I5,9X,A1,7X,A3)
      IF (NAREAS.EQ.0) GO TO 1480
C
C**** READ IN HEADER FOR OUTPUT TABLES
C
      READ (IREADR,180) HDR
  180 FORMAT (20A4)
      IERR=0
```

```
C
C**** READ IN COUNTY TOTALS FOR EACH CATEGORY
C
      CALL READ1
      IF (IERR.EQ.0) GO TO 200
C
C**** HAD A PROBLEM IN READ1, GET OFF WITH DIAGNOSTIC MESSAGE
C
      GO TO 1400
  200 CONTINUE
      WRITE (3,220) HDR
  220 FORMAT ('1'////,20A4)
C
C     DISPLAY FUELS INPUT DATA FROM SUBROUTINE READ1
C
      WRITE (3,240) (FLTOTS(I),I=1,56)
  240 FORMAT ('0FUEL TOTALS READ IN FOLLOW - (NOTE THAT READ1 ROUTINE CA
     1LCULATED THE LGT TRUCKS CATEGORY (NO.28) BY APPORTIONING'/' FROM L
     1GT DUTY GAS (NO. 27) AND HVY DUTY GAS TRUCKS (NO.29))'//(10F12.1))
     1
      WRITE (IPRINT,1260)
      WRITE (IPRINT,220) HDR
      WRITE (IPRINT,260)
  260 FORMAT ('0',17X,'COUNTY-WIDE AREA SOURCE DATA USED IN CALCULATING
     1EMISSIONS BY SOURCE CATEGORY FOR APPORTIONING'////35X,'SULFUR CONT
     1ENT:'//)
      WRITE (IPRINT,280) SC
  280 FORMAT (45X,'ANTHRACITE COAL',10X,'=',F10.1,' PERCENT'/45X,'BITUMI
     1NOUS COAL',10X,'=',F10.1,' PERCENT'/45X,'DISTILLATE OIL',11X,'=',F
     110.1,' PERCENT'/45X,'RESIDUAL OIL',13X,'=',F10.1,' PERCENT'////)
      WRITE (IPRINT,300) AC
  300 FORMAT (36X,'ASH CONTENT:'//45X,'ANTHRACITE COAL',10X,'=',F10.1,'
     1PERCENT'/45X,'BITUMINOUS COAL',10X,'=',F10.1,' PERCENT'///)
      WRITE (IPRINT,320)
  320 FORMAT (31X,'*****************************************************
     1********'//)
      WRITE (IPRINT,340) TONSFW,TONSMB,TONSAF,DAYSF
```

Reproduced from best available copy.

```
  340 FORMAT (36X,'FOREST WILDFIRES',13X,'=',F9.1,' TONS PER ACRE'//,36X
     1,'MANAGED BURNING',14X,'=',F9.1,' TONS PER ACRE'//,36X,'AGRICUL. F
     1IELD BURNING',7X,'=',F9.1,' TONS PER ACRE'//,36X'FROST CONTROL',16
     1X,'=',F9.1,' DAYS PER YEAR'///)
      WRITE (IPRINT,320)
      WRITE (IPRINT,360) CTYDEN
  360 FORMAT (51X,'POPULATION CODE =  ',A1)
C
C     READ IN WEIGHTED APPORTIONING FACTORS OUTPUT FROM CAASE4
C     ON FORMATTED TAPE.
C
C    COUNTIES SHOULD BE IN ORDER BUT ALL DO NOT NECESSARILY HAVE TO BE
C    PROCESSED DURING A GIVEN RUN.    FIND THIS COUNTY
C
  400 READ (ITAPEN,420, END=1440) STATE,JCNTY
  420 FORMAT (11X,F3.0,20X,I5)
      IF (STATE.NE.XSTATE.OR.ICNTY.NE.JCNTY) GO TO 400
C
C   FOUND COUNTY WANTED
C
      BACKSPACE ITAPEN
C
C    READ IN DATA FOR ALL GRID SQUARES THIS COUNTY
C
      DO 480 I=1,NDIMP1
      READ (ITAPEN,440, END=460) ID(I),STATE,JCNTY,X(I),Y(I),AREA(I),(AP
     1PORT(J,I),J=1,56)
  440 FORMAT (I5,6X,F3.0,20X,I5,23X,2F10.0,10X,F10.2,56E13.5)
      IF (STATE.EQ.XSTATE.AND.JCNTY.EQ.ICNTY) GO TO 480
C
C     ENCOUNTERED NEXT COUNTY
C
      BACKSPACE ITAPEN
C
C   TOTAL GRID SQUARES
C
  460 NAREAS=I-1
```

```
      GO TO 520
  480 CONTINUE
C
C     IF FELL THROUGH LOOP THEN DIMENSIONS WERE NOT ADEQUATE
C
      WRITE (IPRINT,500) NDIM,STATE,JCNTY
  500 FORMAT ('1NDIM WAS SET TO',I5,5X,'BUT MORE GRID SQUARES FOR STATE
     1AND COUNTY=',F10.0,I10,5X,'WERE ENCOUNTERED'/'0INCREASE NDIM AND R
     1ESUBMIT JOB')
      ENDFILE ITAPEO
      GO TO 1520
  520 CONTINUE
C
C     DEVELOP THE APPORTIONING FACTOR SUMS FOR EACH EMISSION CATEGORY
C   THESE SUMS ARE USED AS THE DENOMINATORS FOR RATIOS TO APPORTION
C    FUELS AND EMISSIONS INTO EACH GRID SQUARE/SOURCE CATEGORY COMB.
C
      DO 560 J=1,56
      APTOT(J)=0.
      DO 540 I=1,NAREAS
      APTOT(J)=APTOT(J)+APPORT(J,I)
  540 CONTINUE
  560 CONTINUE
C
C     APPORTION THE FUELS AND OUTPUT TO TABLES
C     CALCULATE RATIO OF TOTAL FOR COUNTY IN EACH GRID SQUARE
C
      DO 600 J=1,56
      DO 600 I=1,NAREAS
      IF (APTOT(J).EQ.0.) GO TO 580
      APFUEL(J,I)=APPORT(J,I)/APTOT(J)*FLTOTS(J)
      GO TO 600
  580 APFUEL(J,I)=0.
  600 CONTINUE
C
C     OUTPT1 ROUTINE FORMATS OUTPUT
C
```

```
      CALL OUTPT1(APFUEL,ID,X,Y,AREA,NDIM)
  620 FORMAT ('1')
  640 FORMAT (10F10.2)
  660 FORMAT ('0')
C
C     NOW COMPUTE TOTAL EMISSIONS FOR THE COUNTY FOR EACH POLLUTANT, FOR
C     EACH CATEGORY, WILL APPORTION LATER (STORE IN POLTOT ARRAY)
C
C
C**** RESIDENTIAL FUEL
C
      DO 680 K=1,5
      DO 680 J=1,6
      POLTOT(J,K)=EMFACT(J,K)*FLTOTS(J)
  680 CONTINUE
C
C     HAD ADDITIONAL COEFFICIENTS FOR SOME COMBINATIONS (SULPHUR CONTENT
C     FOR CALCULATION OF SO2)
C
C     RESIDENTIAL FUEL
C
      DO 700 J=1,4
      POLTOT(J,2)=POLTOT(J,2)*SC(J)
  700 CONTINUE
C
C**** COMMERCIAL AND INSTITUTIONAL FUEL
C
      DO 720 K=1,5
      DO 720 J=7,12
      POLTOT(J,K)=EMFACT(J,K)*FLTOTS(J)
  720 CONTINUE
C
C**** TAKE CARE OF ASH CONTENT AND SULFUR CONTENT CASES
C
C     ASH FOR COMMERCIAL AND INSTITUTIONAL (C&I) COAL
C
C   SULFUR FOR C&I FUELS
```

```
C
      DO 740 J=7,8
      K=J-6
      POLTOT(J,1)=POLTOT(J,1)*AC(K)
      POLTOT(J,2)=POLTOT(J,2)*SC(K)
  740 CONTINUE
      DO 760 J=9,10
      K=J-6
      POLTOT(J,2)=POLTOT(J,2)*SC(K)
  760 CONTINUE
C
C**** INDUSTRIAL FUEL
C
C     INCLUDE ASH & SULFUR WHERE REQUIRED
C
      DO 780 J=13,14
      L=J-12
      POLTOT(J,1)=EMFACT(J,1)*FLTOTS(J)*AC(L)
      POLTOT(J,2)=EMFACT(J,2)*FLTOTS(J)*SC(L)
      DO 780 K=3,5
      POLTOT(J,K)=EMFACT(J,K)*FLTOTS(J)
  780 CONTINUE
C
C**** FACTOR FOR COKE
C
      POLTOT(15,1)=EMFACT(15,1)*FLTOTS(15)*AC(2)
      POLTOT(15,2)=EMFACT(15,2)*FLTOTS(15)*SC(2)
      DO 800 K=3,5
      POLTOT(15,K)=EMFACT(15,K)*FLTOTS(15)
  800 CONTINUE
      DO 820 J=16,20
      DO 820 K=1,5
      POLTOT(J,K)=EMFACT(J,K)*FLTOTS(J)
  820 CONTINUE
C
C***** NEED TO ACCOUNT FOR SULFUR CONTENT
      POLTOT(16,2)=POLTOT(16,2)*SC(3)
      POLTOT(17,2)=POLTOT(17,2)*SC(4)
C
C**** ON-SITE INCINERATION AND OPEN BURNING
C
      DO 840 J=21,26
      DO 840 K=1,5
      POLTOT(J,K)=EMFACT(J,K)*FLTOTS(J)
  840 CONTINUE
C***** THE FOLLOWING HAVE ZERO (OR UNDEFINED) EMISSION FACTORS
C
C     THE FOLLOWING CATEGORIES ARE HANDLED IN A SEPARATE ALGORITHM
C  COMBINING FUEL SALES, MILES PER GALLON, TYPE VEHICLE, AND ROAD CLASS.
C     SET VALUE TO ZERO HERE
      DO 900 K=1,5
      DO 860 J=27,29
      POLTOT(J,K)=0.
  860 CONTINUE
      POLTOT(31,K)=0.
      DO 880 J=43,46
      POLTOT(J,K)=0.
  880 CONTINUE
  900 CONTINUE
      DO 960 K=1,5
C
C     OFF HIGHWAY GAS
C
      POLTOT(30,K)=EMFACT(30,K)*FLTOTS(30)
C
C     DIESEL OFF-HIGHWAY (32), DIESEL RAIL (33), AIRCRAFT (34,35,36),
C     VESSELS (37,38,39,40), EVAPORATION (41,42)
C
      DO 920 J=32,42
      POLTOT(J,K)=EMFACT(J,K)*FLTOTS(J)
  920 CONTINUE
C
C      FUGITIVE DUST CATEGORIES
C
```

```
      DO 940 J=47,51
      POLTOT(J,K)=FLTOTS(J)*EMFACT(J,K)
  940 CONTINUE
C
C**** FOREST WILDFIRES
C
C     REQUIRES TONS/ACRE CALCULATION
C
      POLTOT(52,K)=FLTOTS(52)*TONSFW*EMFACT(52,K)
C
C**** MANAGED BURNING
C
      POLTOT(53,K)=FLTOTS(53)*TONSMB*EMFACT(53,K)
C
C**** AGRICULTURAL FIELD BURNING
C
      POLTOT(54,K)=FLTOTS(54)*TONSAF*EMFACT(54,K)
C
C**** FROST CONTROL
C
      POLTOT(55,K)=FLTOTS(55)*DAYSF*EMFACT(55,K)
C
C**** STRUCTURED FIRES
C
      POLTOT(56,K)=FLTOTS(56)*EMFACT(56,K)
  960 CONTINUE
C
C**** NOW DEAL WITH HIGHWAY MOTOR VEHICLE SOURCES
C     THESE CALCULATIONS FOLLOW THE EPA/NADB METHOD, I.E., FUEL SALES
C    AND VEHICLE CLASS MPG ARE USED TO DEVELOP TOTAL VEHICLE MILES
C   TRAVELLED BY VEHICLE CLASS.  THE MEASURED VEHICLE MILES REPORTED ON
C   THE NEDS AREA SOURCE FORM ARE ONLY USED TO DETERMINE RATIOS BY ROAD
C   CLASS FOR THE VMT CALCULATED USING SALES & MPG.
C
C     CONSTANT USED IN CALCULATIONS
C          10000/(453.6*2000)  WHERE 10000 CONVERTS INPUT DATA TO MILES
C                                    453.6 CONVERTS GRAMS TO POUNDS
```

```
C                                      2000  CONVERTS POUNDS TO TONS
C  CONVER = .011023 WAS SET AT START
C**** OBTAIN RATIO FOR EACH VEHICLE CLASS.
C**** LGT VEH GAS -- 13.5 MPG
C
C     FUELS REPORTED IN THOUSANDS OF GALLONS
C
C
      VLGTG=FLTOTS(27)*1.35D4
C
C**** LGT TRUCK GAS -- 11.8 MPG
C
      TLGTG=FLTOTS(28)*1.18D4
C
C**** HVY VEH GAS -- 7.3 MPG
C
      VHVYG=FLTOTS(29)*7.3D3
C
C**** HVY VEH DIESEL -- 5.2 MPG
C
      VHVYD=FLTOTS(31)*5.2D3
C**** NEED RATIO OF EACH   RLD = LGT DUTY GAS, RLDT = LGT DUTY TRUCKS,
C                    RHDG = HVY DUTY GAS, RHDD = HVY DUTY DIESEL
      SUMM=VLGTG+TLGTG+VHVYG+VHVYD
      RLD=VLGTG/SUMM
      RLDT=TLGTG/SUMM
      RHDG=VHVYG/SUMM
      RHDD=VHVYD/SUMM
C
C**** IF MEASURED VEHICLE MILES ARE AVAILABLE  USE THEM...IF NOT USE
C     DENSITY CODE TO ESTIMATE.
C
C**** TOTAL MILES = SUM OF MEASURED VEHICLE MILES
C
      TOTMI=0.
      DO 980 I=43,46
      TOTMI=TOTMI+FLTOTS(I)
```

```
  980 CONTINUE
C
C     IF TOTAL IS ZERO THEN USE ALTERNATE METHOD.
C
      IF (TOTMI.EQ.0.) GO TO 1020
C
C**** CALCULATE EMISSIONS FOR EACH POLLUTANT, EACH MEASURED VEHICLE
C     MILES CLASS
C     POLLUTANT LOOP
C
      DO 1000 K=1,5
      DO 1000 J=1,4
C
C     SUBSCRIPTS FOR MEASURED VEHICLE MILES ARE 43,44,45,46
C     EMISSION FACTORS ARE IN THE ARRAY EFHV WHERE SUBSCRIPTS ARE--
C              VEHICLE CLASS,  ROAD TYPE,   POLLUTANT
C
      JJ=J+42
      POLTOT(JJ,K)=CONVEH*FLTOTS(JJ)*(RLD*EFHV(1,J,K)+RLDT*EFHV(2,J,K)+R
     1HDG*EFHV(3,J,K)+RHDD*EFHV(4,J,K))
 1000 CONTINUE
      GO TO 1140
 1020 CONTINUE
C    ALTERNATE METHOD -- MEASURED VEHICLE MILES ARE MISSING
C    ESTIMATE WILL BE FOR RURAL AND URBAN ONLY BASED ON COUNTY DENSITY
C  (URBANIZATION ) CODE.  IT TOO MAY BE MISSING, IF SO USE WORST CASE
C    THAT CAN BE REPORTED, I.E., 9 INDICATING 90 PERCENT URBANIZATION.
C
C
C
C     BECAUSE OF AMBIGUITY OF BLANK AND ZERO READ WITH NUMERIC FORMAT IN
C    FORTRAN, CTYDEN WAS READ AS ALPHANUMERIC -- DETERMINE BLANK, ZERO
C    THROUGH NINE.
C
      DO 1080 ITOE=1,11
      IF (CTYDEN.NE.TOES(ITOE)) GO TO 1080
      IF (ITOE.NE.1) GO TO 1060
      CTYDEN=9.
      WRITE (IPRINT,1040)
 1040 FORMAT ('1 MISSING COUNTY DENSITY CODE, USED 9')
      GO TO 1100
 1060 CTYDEN=ITOE-2
      GO TO 1100
 1080 CONTINUE
 1100 CONTINUE
C
C   PU IS FRACTION URBAN,  PR IS FRACTION RURAL
C
      PU=CTYDEN/1.0D1
      PR=1.0-PU
C
C      453.6 * 2000 = 907200   CONVERTS GRAMS TO TONS
C      USE MILES FROM MPG CALCULATIONS
C
      TOTMI=VLGTG+TLGTG+VHVYG+VHVYD
      DO 1120 K=1,5
      POLTOT(43,K)=0.
      POLTOT(45,K)=0.
      POLTOT(44,K)=TOTMI*PR*(EFHV(1,2,K)*RLD+EFHV(2,2,K)*RLDT+EFHV(3,2,K
     1)*RHDG+EFHV(4,2,K)*RHDD)/9.072D5
      POLTOT(46,5)=TOTMI*PU*(EFHV(1,4,K)*RLD+EFHV(2,4,K)*RLDT+EFHV(3,4,K
     1)*RHDG+EFHV(4,4,K)*RHDD)/9.072D5
 1120 CONTINUE
 1140 CONTINUE
C
C*** OUTPUT THE COUNTY EMISSION TOTALS FOR EACH SOURCE CATEGORY AND
C   POLLUTANT
C
      DO 1180 K=1,5
      SUMKK(K)=0.0
      DO 1160 J=1,56
      SUMKK(K)=SUMKK(K)+POLTOT(J,K)
 1160 CONTINUE
 1180 CONTINUE
```

```
      WRITE (IPRINT,620)
      WRITE (IPRINT,180) HDR
      DO 1240 K=1,5
      WRITE (IPRINT,1200) POLHDG(K),(POLTOT(J,K),J=1,56)
 1200 FORMAT ('0TOTALS BY SOURCE CATEGORY FOR POLLUTANT ',A4,' (TONS/YR)
     1 '/(10F10.3))
      WRITE (IPRINT,1220) POLHDG(K),SUMKK(K)
 1220 FORMAT ('0FOR POLLUTANT ',A4,' TOTAL EMISSIONS=',F15.3)
 1240 CONTINUE
      WRITE (IPRINT,1260)
 1260 FORMAT (///' FOOTNOTE: CATEGORIES BY ROW IN SAME ORDER AS AREA SOU
     1RCE NEDS FORM AND OUTPUT TABLES')
C
C****  NOW APPORTION THE EMISSIONS TO EACH GRID SQUARE IN THE COUNTY
C     ACCORDING TO APPORTIONING FACTORS CALCULATED BY CAASE4
C
C
C      5 POLLUTANTS BY 56 CATEGORIES X NUMBER OF GRID SQUARES THIS COUNTY
C
      DO 1380 K=1,5
      DO 1300 J=1,56
      PTOTAL=POLTOT(J,K)
      DO 1300 I=1,NAREAS
      IF (APTOT(J).EQ.0.) GO TO 1280
C
C      FRACTION BY CATEGORY AND POLLUTANT PER GRID SQUARE CALCULATION
C
      APFUEL(J,I)=PTOTAL*APPORT(J,I)/APTOT(J)   .
      GO TO 1300
 1280 APFUEL(J,I)=0.
 1300 CONTINUE
C
C****  NEED TO SAVE FOR IPP, OR CDM, OR AQDM
C
      DO 1340 I=1,NAREAS
C
C     SUM ALL CATEGORIES FOR EACH GRID SQUARE FOR EACH POLLUTANT FOR
```

```
C     DISPERSION MODEL AREA SOURCE FORMAT
C
      SUM=0.
      DO 1320 J=1,56
      SUM=SUM+APFUEL(J,1)
 1320 CONTINUE
      OUTIPP(I,K)=SUM
 1340 CONTINUE
      CONTINUE
C
C     NOW OUTPUT APPORTIONED EMISSIONS, LABEL ACCORDING TO POLLUTANT
C
C     ROUTINE OUTPT2 FORMATS AND PRINTS TABLES OF EMISSIONS BY SOURCE
C   CATEGORY AND GRID SQUARE.   CALLED ONCE FOR EACH POLLUTANT
C
      CALL OUTPT2(K,APFUEL,ID,X,Y,AREA,NDIM)
 1380 CONTINUE
C
C**** NOW OUTPUT IPP, OR CDM, OR AQDM CARD IMAGES
C
C
C     ROUTINE OUTPT3 FORMATS, PRINTS, AND PUNCHES DISPERSION MODEL
C     AREA SOURCE INPUT DATA.
C
      CALL OUTPT3(OUTIPP,ID,X,Y,AREA,NDIM,IWANT)
C
C**** DO WE HAVE ANOTHER COUNTY
C
      GO TO 140
 1400 WRITE (IPRINT,1420) ICNTY,JCNTY
 1420 FORMAT ('1TROUBLE WITH COUNTY, WANTED ',I5,'  BUT GOT',I5/'0GET OF
     1F')
      GO TO 1520
 1440 CONTINUE
      WRITE (IPRINT,1460) XSTATE,ICNTY
 1460 FORMAT ('0JUST HIT END OF FILE ON CAASE4 OUTPUT TAPE WHILE TRYING
     1TO PROCESS FIPS STATE AND COUNTY NUMBER',F10.0,I10)
```

```
      GO TO 1520
 1480 WRITE (IPRINT,1500)
 1500 FORMAT ('1NO MORE COUNTIES')
 1520 CONTINUE
      REWIND ITAPEN
      ENDFILE ITAPEO
      REWIND ITAPEO
      RETURN
      END
```

Reproduced from best available copy.

```
      SUBROUTINE READ1
C
C***** ROUTINE READS FUEL TOTALS FROM JOB INPUT STREAM CARDS IN NEDS
C     AREA SOURCE FORMAT FOR COUNTY, STATE, STUDY AREA (AQCR, AQMA, ETC)
C        OF INTEREST.
C
C****CARDS A1 THROUGH A5 ONLY ARE TO BE INPUT
C      RETURNS IERR =0 FOR SUCCESSFUL READ
C              IERR=1 FOR PROBLEMS.
C
      COMMON/WHICH/XSTATE,ICNTY,XAQCR,CNTY,NAREAS,HDR(20),IPOLIT,IREGN
      COMMON /FUELS/KSTATE,KOUNTY,AQCR,YR,SC(4),AC(2),FLTOTS(56),CTYDEN,
     1TONSFW,TONSMB,TONSAF,DAYSF
      COMMON/IOUNIT/IREADR,ITAPET,ITAPEN,ITAPEO,IPUNCH,IPRINT,IERR
      DIMENSION ICARD(5)
      IERR=0
C
C****   FUELS TOTALS TO BE READ IN FROM CARDS  ******
C
      READ (IREADR,5020) LSTATE,LCNTY,AQCR,YR,SC,AC,(FLTOTS(I),I=1,6),
     1ICARD(1),(FLTOTS(I),I=7,20),ICARD(2),(FLTOTS(I),I=21,27),
     2(FLTOTS(I),I=29,33),CTYDEN,ICARD(3),(FLTOTS(I),I=34,46),ICARD(4),
     3(FLTOTS(I),I=47,52),TONSFW,FLTOTS(53),TONSMB,FLTOTS(54),TONSAF,
     4FLTOTS(55),DAYSF,FLTOTS(56),ICARD(5)
 5020 FORMAT (I2,I4,F3.0,F2.0,23X,4F2.1,2F3.1,F5.0,F6.0,F5.0,F4.0,F5.0,
     1F4.0,2X,I1/9X,4F5.0,F4.0,F2.0,2F6.0,F4.0,3F5.0,F3.0,F4.0,6X,I1/
     29X,F6.0,F5.0,F4.0,2F6.0,F5.0,F7.0,3F6.0,2F5.0,A1,2X,I1/
     39X,F4.0,F6.0,F5.0,2F4.0,F5.0,F4.0,F6.0,F5.0,3F6.0,F7.0,2X,I1/
     49X,F7.0,F5.0,F6.0,2F5.0,F7.0,F3.0,F6.0,F3.0,F6.0,F3.0,F4.0,F3.0,
     5F5.0,2X,I1)
      DO 100 I=1,5
      IF(ICARD(I).NE.1) GO TO 200
  100 CONTINUE
C
C     CHECK TO SEE IF COUNTY IS IN SAME ORDER AS CALLING ROUTINE REQUEST
C
      IF(LSTATE.EQ.KSTATE.AND.KOUNTY.EQ.LCNTY.AND.AQCR.EQ.XAQCR) GO
     1 TO 7000
C
C**** DID NOT OBTAIN DATA FOR CORRECT COUNTY, CARDS OUT OF ORDER,
C      SET ERROR CONDITION, PRINT DIAGNOSTIC MESSAGE, AND RETURN
C
      IERR=1
      WRITE(IPRINT,5010) STATE,XSTATE,KOUNTY,LCNTY,AQCR,XAQCR
 5010 FORMAT('1PROBLEM IN READ1, STATE =',2F4.0/' COUNTY =',2I5  /' AQCR
     1=',2F5.0)
      RETURN
C
C    ERROR IN SEQUENCE ORDER OF FUELS TOTALS CARDS, PRINT MESSAGE, QUIT
C
  200 ERR = 1
      WRITE (IPRINT,5000) (ICARD(I),I=1,5)
 5000 FORMAT('1PROBLEM IN READ1, FUELS CARDS OUT OF SEQUENCE'/50X,'ORDER
     1 IS ',2I2)
      RETURN
 7000 CONTINUE
      FLTOTS(28) = FLTOTS(27) * .122 + FLTOTS(29) * .273
      FLTOTS(27) = FLTOTS(27) * .878
      FLTOTS(29) = FLTOTS(29) * .727
      RETURN
      END
      SUBROUTINE OUTPT1 (APFUEL,ID,X,Y,AREA,NDIM)
C
C     CAASES OUTPUT SUBROUTINE OUTPT1- OUTPUTS APPORTIONED FUEL TOTALS
C     FROM APPORTIONING OF COUNTY TOTALS TO SUB-COUNTY GRID SQUARES
C
C**** PLACE 45 GRID SQUARES ON EACH PAGE FOR EACH OF THE 5 TABLES
C     THE FIVE TABLES ARE REQUIRED TO ACCOMMODATE THE COLUMNS NECESSARY
C     FOR ALL SOURCE CATEGORIES ASSOCIATED WITH EACH GRID SQUARE
C
      COMMON/WHICH/XSTATE,ICNTY,XAQCR,CNTY,NAREAS,         HDR(20)
     1,IPOLIT,IREGN
      COMMON /FUELS/KSTATE,KOUNTY,AQCR,YR,SC(4),AC(2),FLTOTS(56),CTYDEN,
     1TONSFW,TONSMB,TONSAF,DAYSF
      COMMON/IOUNIT/IREADR,ITAPET,ITAPEN,ITAPEO,IPUNCH,IPRINT,IERR
      DIMENSION APFUEL(56,NDIM)
      DIMENSION X(NDIM),Y(NDIM),AREA(NDIM),ID(NDIM)
      IPAGE = 0
      ITABLE=1
C
C     IPUT IS FLAG FOR HEADER RECORD ON OUTPUT TO INDICATE THAT
C     APPORTIONED FUELS FOLLOW.
C
      IPUT = 1
      IEND=0
C
C     ISTART TO IEND BRINGS THE ARRAY OUT IN SETS OF 45 GRID SQUARES
C     EACH
C
   50 ISTART=IEND+1
      IEND=ISTART+44
C
C     MAY NOT BE 45 REMAINING--CHECK IT
C
      IEND= MINO(IEND,NAREAS)
      IPAGE=IPAGE+1
   75 WRITE(IPRINT,5000) HDR,ITABLE,IPAGE
 5000 FORMAT('1',20A4,2X,'APPORTIONED FUELS, TABLE ',I2,', PAGE ',
     112/'0')
C
C     TABLE HEADINGS AND FORMATS DEPENDENT ON WHICH SOURCE CATEGORIES
C       FOR THIS TABLE
C
      GO TO (100,200,300,400,500),ITABLE
  100 CONTINUE
C
C**** OUTPUT GRID SQUARE IDENTIFIERS AND FIRST 6 SOURCE CATEGORIES
C
      WRITE (IPRINT,5100)
      DO 125 I=ISTART,IEND
      WRITE (IPRINT,5110)  ID(I), IREGN, IPOLIT, CNTY, X(I),Y(I),AREA(I)
     1,(APFUEL(J,I),J=1,6)
 5110 FORMAT(11X,
     1   I6,4X,A3,6X,A1,5X,A4,F9.1,F8.1,F9.2,F7.1,F9.1,2F10.1,F11.1,
     2  F8.1)
  125 CONTINUE
      GO TO 600
  200 CONTINUE
C
C***** OUTPUT GRID SQUARE NUMBERS AND SOURCE CATEGORIES 7 THROUGH 20
C
      WRITE(IPRINT,5200)
      DO 225 I=ISTART,IEND
      WRITE(IPRINT,5210)  ID(I), CNTY, (APFUEL(J,I),J=7,20)
 5210 FORMAT(I6,4X,A4,F8.1,F7.1,F9.1,F10.1,F9.1,F8.1,F7.1,F7.1,
     1 F7.1,F10.1,F11.1,F9.1,2F7.1)
  225 CONTINUE
      GO TO 600
  300 CONTINUE
C
C***** OUTPUT GRID SQUARE NUMBERS AND SOURCE CATEGORIES 21 THROUGH 33
C
      WRITE(IPRINT,5300)
       DO 325 I=ISTART,IEND
      WRITE(IPRINT,5310) ID(I), CNTY, (APFUEL(J,I),J=21,33)
  325 CONTINUE
      GO TO 600
  400 CONTINUE
C
C***** OUTPUT GRID SQUARE NUMBERS AND SOURCE CATEGORIES 34 THROUGH 46
C
      WRITE (IPRINT,5400)
      DO 425 I=ISTART,IEND
      WRITE (IPRINT,5410) ID(I), CNTY, (APFUEL(J,I),J=34,46)
  425 CONTINUE
      GO TO 600
  500 CONTINUE
C
C***** OUTPUT GRID SQUARE NUMBERS AND SOURCE CATEGORIES 47 THROUGH 56
C
      WRITE (IPRINT,5500)
      DO 525 I=ISTART,IEND
      WRITE (IPRINT,5510) ID(I), CNTY, (APFUEL(J,I),J=47,52),TONSFW,
     1APFUEL(53,I),TONSMB, APFUEL(54,I), TONSAF, APFUEL(55,I), DAYSF,
     2APFUEL(56,I)
  525 CONTINUE
  600 CONTINUE
C
C***** UPDATE TABLE NUMBER OF THIS SET (45 OR LESS) OF GRID SQUARES
C
      ITABLE= ITABLE +1
      IF (ITABLE.LE.5)  GO TO 75
C
C***** UPDATE WHICH SET OF GRID SQUARES TO OUTPUT, QUIT IF DONE
C
      ITABLE= 1
      IF (NAREAS.EQ.IEND)  GO TO 700
      GO TO 50
  700 CONTINUE
C
C**** OUTPUT FORMATTED TAPE, WHERE:
C     ALL ALPHANUMERICS ARE A4
```

```
C     ALL INTEGERS ARE I10
C     ALL REAL*4 ARE E13.5
C
C      FORMATTED TAPE CONTAINS ONLY DATA, I.E., IT IS NOT A 'PRINT' TAPE
C
C      WRITE HEADER RECORD ON OUTPUT:
C                    NAREAS INDICATES HOW MANY RECORDS FOLLOW
C                    IPUT INDICATES TYPE OF DATA, I.E., APPORTIONED
C                          FUELS = 1, APPORTIONED EMISSIONS = 2
C
       WRITE(ITAPEO,5050) IREGN,STATE,KOUNTY,NAREAS,IPUT,TONSFW,TONSMB,
     1 TONSAF,DAYSF
 5050 FORMAT(1X,A4,E13.5,3I10,4E13.5)
       DO 750 I=1,NAREAS
C
C      WRITE RECORD ON OUTPUT TAPE FOR EACH GRID SQUARE
C
       WRITE(ITAPEO,5060) ID(I),X(I),Y(I),AREA(I),(APFUEL(J,I),J=1,56)
 5060 FORMAT(I10,59E13.5)
  750 CONTINUE
  800 RETURN
 5100 FORMAT('0',68X,'****************** RESIDENTIAL FUEL ***************
     1**'/12X,'SOURCE',10X,'POLIT',12X,'COORDINATES',13X,'ANTH.   BITUM.     5100
     2  DIST.OIL   RES.OIL   NAT.GAS   WOOD'/12X,'NUMBER  REGION  JURIS     5100
     3 COUNTY   X(KM)   Y(KM)  (SQ.KM)   10E1T   10E1T    10E4GALS  10E     5100
     44GALS   10E7FT3  10E2T'//)                                            5100
 5200 FORMAT('0',17X,'****** COMMERCIAL AND INSTITUTIONAL FUEL *******
     1*********************** INDUSTRIAL FUEL **************************'/2     5200
     2X,'SOURCE',10X,'ANTH.  BITUM.  DIST.OIL  RES.OIL  NAT.GAS  WOOD          5200
     3ANTH.  BITUM.  COKE   DIST.OIL  RES.OIL  NAT.GAS  WOOD  PROC.GAS'/     5200
     42X,'NUMBER  COUNTY  10E1T  10E1T   10E4GALS  10E4GALS 10E7FT3  10E     5200
     52T  10E1T  10E1T  10E1T   10E4GALS  10E4GALS 10E7FT3  10E2T  10E7F     5200
     6T3'//)                                                                5200
 5300 FORMAT('0',
     1         16X,'* ON SITE INCINERATION *  ***** OPEN BURNING ****  *** OUTPT1
     1******* GASOLINE FUEL ***********  ********* DIESEL FUEL ******'/,2X OUTPT1
     2,'SOURCE',10X,'RESID.  INDUST.  C-INST.  RESID.  INDUST.  C-INST.  OUTPT1
     3 LT.VEH.  LT.TRUK  HV.VEH.  OFF HIWY  HV.VEH.  OFF HIWY  R.LOCO',  OUTPT1
     4/,2X,'NUMBER  COUNTY  10E1T    10E1T    10E1T   10E1T    10E1T   1 OUTPT1
     50E1T    10E3GAL  10E3GAL  10E3GAL  10E3GAL   10E3GAL  10E3GAL   10 OUTPT1
     6E3GAL'//)                                                          OUTPT1
5310 FORMAT(I6,4X,A4,F9.1,2F8.1,F10.1,F8.1,5F9.1,F8.1,F11.1,F10.1)
5400 FORMAT('0',17X,'****** AIRCRAFT ******  *********** VESSELS *******
     1***  *** EVAPORATION ***  ******* MEASURED VEHICLE MILES ******'/2    5400
     2X,'SOURCE',10X,'MILIT.  CIVIL  COMM''L,  BITUM. DE. OIL  RES.OIL      5400
     3GAS   SOL.PUR.  GAS.MKTD.  LTD.ACC.  RUR.RDS.  SUB.RDS.  URB.RDS.'    5400
     4/2X,'NUMBER  COUNTY  LC10E2  LC10E1 LC10E1   10E1T  10E4GAL 10E4GA    5400
     5L 10E3GAL  TONS/YR  10E5GALS    10E4MI    10E4MI    10E4MI    10E4    5400
     6MI'//)                                                                5400
5410 FORMAT(I6,4X,A4,4F8.1,F7.1,F10.1,F7.1,F9.1,5F10.1)
5500 FORMAT('0',25X,'DIRT',12X,'MISC.',48X,'AGRICULTURAL   FROST CONTRO OP15500
     1L'/16X,'DIRT RDS  AIR    CONSTR.  WIND     LAND    FOREST WILD FIR OP15500
     2ES  MANAGED BURNING  FIELD BURNING  ORCH.    DAYS   STRUC.'/'  SOU OP15500
     3RCE',8X,'TRAVELED STRIPS   ACRES  EROSION  TILLING  ACR BURN   QUA OP15500
     4NT. ACR BURN   QUANT ACR BURN QUANT  BURN.    FIRED  FIRES'/'  NUM OP15500
     5BER COUNTY  10E3MI LTO CYC  10E3ACR',30X,'T/ACR',13X,'T/ACR',10X,  OP15500
     6'T/ACR',11X,'DY/YR   #/YR'//)                                      OP15500
5510 FORMAT(I6,4X,A4,F8.1,3F8.1,F10.1,F8.1,2F10.1,2F8.1,F7.1,F8.1,F7.1,
     1F9.1)
      END
```

```
C
C      CAASES OUTPUT SUBROUTINE OUTPT2 OUTPUTS APPORTIONED EMISSIONS
C      FROM APPORTIONING OF COUNTY TOTALS TO SUB-COUNTY GRID SQUARES.
C     K IN THE CALL LIST DETERMINES WHICH OF THE FIVE POLLUTANTS IS TO BE
C      OUTPUT
C**** PLACE 45 GRID SQUARES ON EACH PAGE FOR EACH OF THE 5 TABLES
C     THE FIVE TABLES ARE REQUIRED TO ACCOMMODATE THE COLUMNS NECESSARY
C      FOR ALL SOURCE CATEGORIES ASSOCIATED WITH EACH GRID SQUARE
C
       SUBROUTINE OUTPT2 (K,APFUEL,ID,X,Y,AREA,NDIM)
       COMMON/WHICH/XSTATE,ICNTY,XAQCR,CNTY,NAREAS,         HDR(20)
      1,IPOLIT,IREGN
       COMMON /FUELS/KSTATE,KOUNTY,AQCR,YR,SC(4),AC(2),FLTOTS(56),CTYDEN,
      1TONSFW,TONSMB,TONSAF,DAYSF
       COMMON/IOUNIT/IREADR,ITAPET,ITAPEN,ITAPEO,IPUNCH,IPRINT,IERR
       DIMENSION APFUEL(56,NDIM)
       COMMON /TOTPOL/POLTOT(56,5)
       DIMENSION X(NDIM),Y(NDIM),AREA(NDIM),ID(NDIM)
       DIMENSION POLL(25)
C
C      POLL ARRAY CONTAINS LABELS FOR THE FIVE POLLUTANTS.
C
       DATA POLL/'   (','PART','ICUL','ATE)','    ',' (S','ULPH','UR D',
      1'IOXI','DE) ','(OXI','DES ','OF N','ITRO','GEN)','   (','HYDR','OC
      2AR','BONS',')   ',' (C','ARBO','N MO','NOXI','DE) '/
       IPAGE = 0
C
C      IPOT USED IN OUTPUT TAPE HEADER RECORD TO INDICATE TYPE OF
C      DATA FOLLOWING.
C
       IPOT=2
       XK=K
C
C      DUMMY VARIABLE TO FILL RECORD LENGTH ON OUTPUT TAPE HEADER RECORD
C
       DUM=0.
       ITABLE = 1
      IEND = 0
C
C**** SET PROPER POLLUTANT HEADING
C
      KJ = K*5
      KK = KJ-4
C
C    ISTART TO IEND BRINGS THE ARRAY OUT IN SETS OF 45 GRID SQUARES EACH
C
   50 ISTART = IEND + 1
      IEND = ISTART +44
C
C     MAY NOT BE 45 REMAINING,  CHECK IT.
C
      IEND = MINO(IEND,NAREAS)
      IPAGE = IPAGE + 1
   75 WRITE(IPRINT,5000) HDR,ITABLE,IPAGE
 5000 FORMAT('1',20A4,2X,'APPORTIONED EMISSIONS, TABLE ',I2,', PAGE ',
     1I2/)
C
C     WRITE POLLUTANT LABEL
C
      WRITE(IPRINT,5001) (POLL(IK),IK=KK,KJ)
 5001 FORMAT(91X,5A4)
      WRITE (IPRINT,5002)
 5002 FORMAT(94X,'(TONS PER YEAR)'/'0')
C
C    TABLE HEADINGS AND FORMATS DEPENDENT ON WHICH SOURCE CATEGORIES
C     FOR THIS TABLE
C
      GO TO (100,200,300,400,500),ITABLE
  100 CONTINUE
C
C**** OUTPUT GRID SQUARE IDENTIFIERS AND FIRST 6 SOURCE CATEGORIES
C
      WRITE (IPRINT,5100)
 5100 FORMAT('0',11X,'SOURCE',10X,'POLIT',12X,'COORDINATES',13X,'******* UP25100
     1********** RESIDENTIAL FUEL ******************'/12X,'NUMBER  REGION OP25100
     2  JURIS  COUNTY   X(KM)   Y(KM)  (SQ.KM)   ANTH.   BITUM.   DIST.O OP25100
     3IL   RES.OIL   NAT.GAS   WOOD'//)                                  OP25100
      DO 125 I=ISTART,IEND
      WRITE(IPRINT,5110) ID(I),IREGN,IPOLIT,CNTY,X(I),Y(I),AREA(I)
     1,(APFUEL(J,I),J=1,6)
 5110 FORMAT(11X,I6,4X,A3,6X,A1,
     1 5X,A4,F9.1,F8.1,F9.2,F7.1,F9.1,2F10.1,F11.1,F8.1)
  125 CONTINUE
      GO TO 600
  200 CONTINUE
C
C**** OUTPUT GRID SQUARE NUMBERS AND SOURCE CATEGORIES 7 THROUGH 20
C
      WRITE(IPRINT,5200)
 5200 FORMAT('0',  ' SOURCE',10X,'****** COMMERCIAL AND INSTITUTIONAL FU OP25200
     2EL *******  ************************* INDUSTRIAL FUEL ************** OP25200
     2**********'/2X,'NUMBER  COUNTY  ANTH.  BITUM.  DIST.OIL  RES.OIL   OP25200
     3NAT.GAS  WOOD   ANTH.  BITUM.  COKE   DIST.OIL  RES.OIL  NAT.GAS   OP25200
     4WOOD  PROC.GAS'//)                                                 OP25200
      DO 225 I=ISTART,IEND
      WRITE(IPRINT,5210) ID(I), CNTY, (APFUEL(J,I),J=7,20)
 5210 FORMAT(I6,4X,A4,F8.1,F7.1,F9.1,F10.1,F9.1,F8.1,F7.1,F7.1,
     1 F7.1,F10.1,F11.1,F9.1,2F7.1)
  225 CONTINUE
      GO TO 600
  300 CONTINUE
C
C**** OUTPUT GRID SQUARE NUMBERS AND SOURCE CATEGORIES 21 THROUGH 33
C
      WRITE(IPRINT,5300)
 5300 FORMAT('0',' SOURCE',10X,                                         OUTPT2
     1         '* ON SITE INCINERATION *  ***** OPEN BURNING ****  *** OUTPT2
     1******* GASOLINE FUEL **********  ******** DIESEL FUEL ******'/,2X OUTPT2
     3,'NUMBER  COUNTY  RESID.  INDUST.  C-INST.  RESID.  INDUST.  C-INS OUTPT2
     4T.  LT.VEH.  LT.TRUK  HV.VEH.  OFF HIWY  HV.VEH.  OFF HIWY  R.LOCO OUTPT2
     5'//)                                                              OUTPT2
```

```
      DO 325 I=ISTART,IEND
      WRITE(IPRINT,5310) ID(I), CNTY, (APFUEL(J,I),J=21,33)
 5310 FORMAT(I6,4X,A4,F9.1,2F8.1,F10.1,F8.1,5F9.1,F8.1,F11.1,F10.1)
  325 CONTINUE
      GO TO 600
  400 CONTINUE
C
C**** OUTPUT GRID SQUARE NUMBERS AND SOURCE CATEGORIES 34 THROUGH 46
C
      WRITE(IPRINT,5400)
 5400 FORMAT('0',  ' SOURCE',10X,'****** AIRCRAFT ******  ********** VES OP25400
     1SELS **********  *** EVAPORATION ***  ******* MEASURED VEHICLE MIL OP25400
     2ES *******'/'  NUMBER  COUNTY  MILIT.  CIVIL  COMM''L.  BITUM. DE.
     A ',                                                               '
     3OIL  RES.OIL  GAS   SOL.PUR.  GAS.MKTD.  LTD.ACC.  RUR.RDS.  SUB.R OP25400
     4DS.  URB.RDS.'//)                                                 OP25400
      DO 425 I=ISTART,IEND
      WRITE(IPRINT,5410) ID(I), CNTY, (APFUEL(J,I),J=34,46)
 5410 FORMAT(I6,4X,A4,4F8.1,F7.1,F10.1,F7.1,F9.1,F10.1,F9.1,3F10.1)
  425 CONTINUE
      GO TO 600
  500 CONTINUE
C
C**** OUTPUT GRID SQUARE NUMBERS AND SOURCE CATEGORIES 47 THROUGH 56
C
      WRITE(IPRINT,5500)
 5500 FORMAT('0',25X,'DIRT',12X,'MISC.',48X,'AGRICULTURAL   FROST CONTRO OP25500
     1L'/'  SOURCE',8X,'DIRT RDS  AIR    CONSTR.. WIND     LAND    FORES OP25500
     2T WILD FIRES  MANAGED BURNING  FIELD BURNING  ORCH.    DAYS   STRU OP25500
     4C.'/'  NUMBER COUNTY TRAVELED STRIPS   ACRES  EROSION   TILLING  AC OP25500
     5R BURN   QUANT. ACR BURN   QUANT ACR BURN QUANT  BURN.    FIRED  F OP25500
     6IRES'//)                                                          OP25500
      DO 525 I=ISTART,IEND
      WRITE(IPRINT,5510) ID(I), CNTY, (APFUEL(J,I),J=47,52), TONSFW,
     1APFUEL(53,I), TONSMB, APFUEL(54,I), TONSAF, APFUEL(55,I), DAYSF,
     2APFUEL(56,I)
 5510 FORMAT(I6,4X,A4,F8.1,3F8.1,F10.1,F8.1,2F10.1,2F8.1,F7.1,F8.1,F7.1,
     1F9.1)
  525 CONTINUE
  600 CONTINUE
C
C**** UPDATE TABLE NUMBER FOR THIS SET (45 OR LESS) OF GRID SQUARES
C
      ITABLE = ITABLE + 1
      IF(ITABLE.LE.5 ) GO TO 75
C
C**** UPDATE WHICH SET OF GRID SQUARES TO OUTPUT,  QUIT IF DONE
C
      ITABLE = 1
      IF(NAREAS.EQ.IEND) GO TO 700
      GO TO 50
  700 CONTINUE
C
C**** OUTPUT FORMATTED TAPE, WHERE:
C    ALL ALPHANUMERICS ARE A4
C    ALL INTEGERS ARE I10
C    ALL REAL*4 ARE E13.5
C
C     FORMATTED TAPE CONTAINS ONLY DATA, I.E., IT IS NOT A 'PRINT' TAPE
C
C     WRITE HEADER RECORD ON OUTPUT TAPE:
C                   NAREAS INDICATES HOW MANY RECORDS FOLLOW;
C                   IPUT INDICATES TYPE OF DATA, I.E., APPORTIONED
C                        FUELS = 1, APPORTIONED EMISSIONS = 2
C
      WRITE(ITAPEO,5050) IREGN,STATE,KOUNTY,NAREAS,IPUT,XK,DUM,DUM,DUM
 5050 FORMAT(1X,A4,E13.5,3I10,4E13.5)
      DO 750 I=1,NAREAS
C
C     WRITE RECORD ON OUTPUT TAPE FOR EACH GRID SQUARE
C
      WRITE(ITAPEO,5060) ID(I),X(I),Y(I), AREA(I),(APFUEL(J,I),J=1,56)
 5060 FORMAT(I10,59E13.5)
  750 CONTINUE
```

Reproduced from best available copy.

```
      WRITE(ITAPED,5070)
     1                   (PULTOT(J,K),J=1,56)
 5070 FORMAT (56E13.5)
  800 CONTINUE
      RETURN
      END
      SUBROUTINE OUTPT3 (OUTIPP,ID,X,Y,AREA,NDIM,IWANT)
C
C     ROUTINE OUTPUTS THE IPP AREA SOURCE INPUT CARDS, ONE FOR EACH
C     GRID BOX, SO2,SP,NOX,HC,AND CO  SUMMED THROUGH ALL CATEGORIES
C     FOR EACH GRID SQUARE OR CDM AREA SOURCE INPUT CARD, ONE FOR EACH
C     GRID SQUARE, SO2 AND SP, OR AQDM AREA SOURCE INPUT CARDS, ONE FOR
C     EACH GRID SQUARE, SO2 AND SP
C
C*****  CONVERT TONS/YR TO TONS/DAY
C
      DIMENSION OUTIPP(NDIM,5)
      COMMON/WHICH/XSTATE,ICNTY,XAQCR,CNTY,NAREAS,          HDR(20)
     1,IPOLIT,IREGN
      COMMON /FUELS/KSTATE,KOUNTY,AQCR,YR,SC(4),AC(2),FLTOTS(56),CTYDEN,
     1TONSFw,TONSMB,TONSAF,DAYSF
      COMMON/IOUNIT/IREADR,ITAPET,ITAPEN,ITAPEO,IPUNCH,IPRINT,IERR
      DIMENSION X(NDIM),Y(NDIM),AREA(NDIM),ID(NDIM)
      DIMENSION FMT(18)
      DATA FMT/'(A3,',''''999','9'', ','    ','    ',',',''0''',
     1',I4,','I5,I','4, 1',
     2               'X,A1', ',I4,','5F7.','3,2I','5,2X',
     3',''A''',')    '/
      DATA ZERO1  /
     1'''0'' '/,ZERO2/'''00'''/,ZERO31/'''000' /,ZERO32/'''    '/,
     1BLANK/'    ' /
      DATA XI3/',I3,'/,XI2/',I2,'/,XI1/',I1,'/,XI4/',I4,'/
      ISTATE=xSTATE
C
C     SELECT TYPE OF OUTPUT
C   IF IWANT = 1 ROUTINE OUTPUTS THE IPP CARD IMAGES (NOX, HC, AND CO
C     ARE PLACED IN UNUSED COLUMNS OF THE IPP CARDS)
C   IF IWANT = 2 CDM AREA SOURCE INPUT CARD IMAGES ARE OUTPUT
C   IF IWANT = 3 AQDM AREA SOURCE INPUT CARD IMAGES ARE OUTPUT
C
      GO TO (1000,2000,3000), IWANT
C
C*****VALUE OF IWANT OUT OF RANGE
```

```
C
      WRITE(IPRINT,5000) IWANT
 5000 FORMAT('1 VALUE OF IWANT OUT OF GO TO RANGE, IWANT = ',I5)
      RETURN
C
C**** OUTPUT IPP CARD IMAGES
C
C     SET STACK HEIGHT TO 33FT. (APPROXIMATELY 10 METERS)
C
 1000 ISTACK = 33
      WRITE(IPRINT,5006) HDR
 5006 FORMAT('1',20A4,5X,'IPP INPUT CARD IMAGES'///)
      DO 100 I=1,NAREAS
C
C     SET COORDINATES AND AREA TO INTEGERS
C
      IX=X(I)*10.+.5
      IY=Y(I)*10.+.5
      IAREA=AREA(I)*10.+.5
C
C     CONVERT EMISSIONS FROM TONS/YR TO TONS/DAY
C
      SO=OUTIPP(I,2)/365.
      SP=OUTIPP(I,1)/365.
      XNO=OUTIPP(I,3)/365.
      HC =OUTIPP(I,4)/365.
      CO =OUTIPP(I,5)/365.
      IDD=ID(I)
C
C**** CONSTRUCT FORMAT FOR LEADING ZEROES (REQUIRED IN IPP DISPERSION
C     MODEL)
C**** MOST WILL BE THREE DIGIT
C
    5 IF(IDD.GE.100.AND.IDD.LT.1000) GO TO 30
      IF(IDD.GE.1000) GO TO 40
      IF(IDD.GT.9) GO TO 10
C
```

```
C***  LESS THAN 10 (1 DIGIT)
C
      FMT(4) = ZERO31
      FMT(5) = ZERO32
      FMT(6) = XI1
      GO TO 50
C
C***  BETWEEN 10 AND 100 ( 2 DIGITS)

   10 CONTINUE
      FMT(4) = ZERO2
      FMT(5) = BLANK
      FMT(6) = XI2
      GO TO 50
C
C**** BETWEEN 100 AND 1000 ( 3 DIGITS)
C
   30 FMT(4) = ZERO1
      FMT(5) = BLANK
      FMT(6) = XI3
      GO TO 50
C
C***  1000 OR GREATER ( 4 DIGITS)
C
   40 CONTINUE
      FMT(4) = BLANK
      FMT(5) = BLANK
      FMT(6) = XI4
   50 CONTINUE
      WRITE(IPUNCH,FMT ) IREGN,ID(I),IX,IY,IAREA,IPOLIT,ISTACK,
     1SO,SP,XNO,HC,CO,ISTATE,KOUNTY
      WRITE(IPRINT,5005) IREGN,ID(I),IX,IY,IAREA,IPOLIT,ISTACK,
     1SO,SP,XNO,HC,CO,ISTATE,KOUNTY
 5005 FORMAT(1X,A3,'9999',I4,'0',I4,I5,I4,1X,A1,I4,5F7.3,2I5,2X,'A')
C
C     WRITE CARD IMAGE TO TAPE
C
```

```
   99 WRITE(ITAPEO,FMT)  IREGN,ID(I),IX,IY,IAREA,IPOLIT,ISTACK,
     1SO,SP,XNO,HC,CO,ISTATE,KOUNTY
  100 CONTINUE
      GO TO 110
C
C**** OUTPUT CDM INPUT CARD IMAGES
C
C
C     SET STACK HEIGHT TO 10 METERS
C
 2000 STAK = 10.0
      CONV = 10.5
      WRITE(IPRINT,5011) HDR
 5011 FORMAT('1',20A4,5X,'CDM INPUT CARD IMAGES'///)
      DO 200 I=1,NAREAS
C
C     SET COORDINATES AND SIDE LENGTH TO INTEGER METERS
C
      IXCORD = X(I) * 1000. + .5
      IYCORD = Y(I) * 1000. + .5
      IWITH = SQRT(AREA(I)) * 1000. + .5
C
C     CONVERT TONS/YR TO GRAMS/SECOND
C
      SP = OUTIPP(1,1)/365. * CONV
      SO = OUTIPP(1,2)/365. * CONV
      WRITE(IPUNCH,5020) IXCORD,IYCORD,IWITH,SP,SO,STAK
 5020 FORMAT(I6,2I7,2F8.5,F7.1)
      WRITE(IPRINT,5021) IXCORD,IYCORD,IWITH,SP,SO,STAK
 5021 FORMAT(1X,I6,2I7,2F8.5,F7.1)
C
C     WRITE CARD IMAGE TO TAPE
C
      WRITE(ITAPEO,5020) IXCORD,IYCORD,IWITH,SP,SO,STAK
  200 CONTINUE
      GO TO 110
```

```
C
C**** OUTPUT AQDM INPUT CARD IMAGES
C
C     SET STACK HEIGHT TO 33FT (APPROXIMATELY 10 METERS)
C
 3000 STACK = 33.0
      WRITE(IPRINT,5029) HDR
 5029 FORMAT('1',20A4,5X,'AQDM INPUT CARD IMAGES'///)
      WRITE(IPUNCH,55) NAREAS
   55 FORMAT(' NSCORD=  ',I9,',')
C
C     CONVERT TONS/YR TO TONS/DAY
C
      SP = OUTIPP(1,1)/365.
      SO = OUTIPP(1,2)/365.
C
C     FIRST CARD NEEDS 'SORCE=' FOR NAME LIST
C
      WRITE (IPUNCH,60) X(1),Y(1),AREA(1),SO,SP,STACK
   60 FORMAT(' SORCE=    ',F9.1,',',F9.1,',',F9.2,',',F9.3,',',F9.3,',',
     1F9.3,',',F9.1,',')
      WRITE(IPRINT,5030) X(1),Y(1),AREA(1),SO,SP,STACK
C
C     WRITE CARD IMAGE TO TAPE
C
      WRITE(ITAPEO,5030) X(1),Y(1),AREA (1),SO,SP,STACK
C
C     OUTPUT REMAINDER OF CARD
C
      DO 300 I=2,NAREAS
      SP = OUTIPP(I,1)/365.
      SO = OUTIPP(I,2)/365.
      WRITE(IPUNCH,5030) X(I),Y(I),AREA(I),SO,SP,STACK
 5030 FORMAT(10X,F9.1,',',F9.1,',',F9.2,',',F9.3,',',F9.3,',',F9.1,',')
      WRITE(IPRINT,5030) X(I),Y(I),AREA(I),SO,SP,STACK
C
C     WRITE CARD IMAGE TO TAPE
```

```
C
      WRITE(ITAPEO,5050) X(I),Y(I), AREA(I),SO,SP,STACK
  300 CONTINUE
  110 CONTINUE
      RETURN
      END
```

APPENDIX F

GTGR TABLES AND FORTRAN SOURCE CODE LISTINGS
DIRECT ACCESS FILE CREATION PROGRAM

Reproduced from best available copy.

```
00 00 000  000 000 000 000 000 000 000 000 000 000 000 000
2+2000571788-335175649+099974767+3251093-03899+78420-0054-0141
3+2003826922-435228892+100131775+3259317-04326+78591-006 -0143
4+2007090708-535439319+100289144+326839 -04757+78782-0 67-0145
5+2010364010-635807315+100446917+3278350-05194+78904-0074-0146
6+2013647701-73633 302+100605135+3289179-05636+79227-0081-0148
7+2016942664-837017747+100763838+330 897-06084+79480-0088-0150
8+2020249795-937861155+100923070+3313517-06537+7975 -0 95-0152
00000 000 000 000 000 0000 000 000 000 000  00 000  000000 00
2+2100542603-331846280+099966809+3407502-04058+77986-0052-0148
3+2103954311-431891128+10 122943+3416063-04505+78152-0 59-0150
4+2107375029-532092284+10 279430+3425523-04956+783 8-0 65-0151
5+2110805660-632450119+100436309+3435892-05413+78545-0072-0153
6+2114247119-732965047+100593622+3447180- 5876+78771-0079-0155
7+2117700331-833637521+100751409+3459400- 6345+79019-0086-0157
8+2121 66233-934468037+100909712+3472563-06819+7928 -0093-0159
000 000 000 000 000  000 000 000 000 000 000 000 0000 00 0000
2+220 505302-328360942+099 58538+3563023-04212+77532-0 50-0155
3+2204072691-428397064+100113760+3571912-04678+77693-0 57-0156
4+2207649438-528588576+100269323+3581738-05150+77874-0064-0158
5+2211236484-628935838+10 425268+3592514-05627+78074-0070-0160
6+2214834786-729439253+100581635+3604250-06110+78295-0077-0162
7+2218445310-830099261+100738464+3616959-06 00+78537-0084-0164
8+2222069033-930916347+10 895796+3630653-07095+78799-0 91-0166
0000 000 0000 000 000 000 000 000 000 000 000 0000000000000
2+2300459578-324720543+099949965+3717617-04360+77059-0049-0161
3+2304181717-424747618+100104235+372682 -04846+77214-005 -0163
4+2307913548-524929124+100258835+3737005-053 7+77389-0062-0165
5+2311656056-625265411+100413805+3748176-05835+77584-0068-0167
6+2315410234-725756870+100569185+3760348-06338+77 99-0075-0169
7+2319177090-826403931+100725015+3773534-06848+78034-0082-0171
8+232 957644-927207063+100881335+3787746-07365+78290-0 89-0173
0000 000 000 000 000 000 0000000000000 000 000 000 000 000 000
2+2400405135-320926030+099941102+3871245-04503+76566-0047-0168
3+2404281051-420943746+100 94380+383075 -05008+76716-0053-0169
4+2408166985-521114896+100247977+3891282-05519+76885-006 -0171
5+2412063958-621439820+100401933+3902837-06037+77074-006 -0173
6+2415973006-721918894+10 556285+3915433-06560+77282-0 73-0176
7+2419895175-822552536+100711075+3929082-07090+77511-0080-0178
8+2423831526-923341203+100866342+394379 -07627+77760-0 86-0180
000 000 000 000 000 0000000 00000000 0000000 000 000 000 000
2+2500341688-316978388+099931958+4023868-04640+76054-0045-0174
3+2504370371-416986446+100084206+4033672-05165+76198-0051-0176
4+2508409384-517146902+100236762+4044531-05695+76361-0058-0178
5+2512459789-617460084+100389663+4056457-06232+76543-0064-0180
6+2516522659-717926356+100542948+4069464-06776+76745-0071-0182
7+2520599081-818546122+100696658+4083564-07326+76967-0077-0185
8+2524690156-919319826+100850831+4098771-07883+77209-0084-0187
0000 000 0000000 000 000 000 000 000 000 000 0000000000 000
2+2600268961-312878641+099922546+4175448-04771+75523-0043-0180
```

Preceding page blank

```
3+2604449362-412876753+100073726+4185 34-05315+75661-0049-0182
4+2608640393-513026190+100225200+4196712-05865+75817-0055-0184
5+2612843155-613327265+100377008+4208907-06421+75903-0062-0187
6+2617058761-713780330+100529187+42  402-06984+76189-0068-0189
7+2621288336-814385777+100681777+4236939-075 4+76404-0075-0191
8+2625533021-915144034+100834816+4252623-08131+76639-0082-0194
0000 0000000 000 000 000 000  00 000  00 000 0000000000000000
2+2700186693-308627851+09  12877+4325947-04897+74973-0041-0186
3+2704517724-408615743+10 062951+4336302-05459+75104-0047-0189
4+2708 59674-508753846+100213306+4347788-06028+7525 -0053-0191
5+2713213681-609042462+100363982+4360418-06604+75424-006 - 193
6+2717580896-709481930+100515016+4374207-07186+75613-0 66-0195
7+2721962485-810072627+1006 0446+4389167-077 5+75821-0073-0198
8+2726359625-910814968+100818312+4 05313-08372+76048-0 79-0200
00 000 0000 0000000000 0000000 000 000 000 000 000 000 000
2+2800094633-3042 7120+099902963+4475327-05016+74 04-0039-0193
3+2804575169-404204527+100 51893+4485938-05 97+74529-0045-0195
4+2809066 90 -5043309 6+100201093+4497719-06185+74673-0051-0197
5+2813571000-604606814+100350598+4510681-06779+74836-0057-0199
6+2818088661-705032308+100500448+4524840-07381+75017-0064-0202
7+2822621084-805607838+100650680+4540209-07989+75218-0070- 204
8+2827169486-906333808+100801333+4556802-08606+75438-0077-0207
000 000 0000000000000000000 000 000 0000000000 000000  0 0
2+2899992543-299677583+099892818+4623551-05129+73817-0037-0199
3+2904621421-399644256+100040567+4634 06-05728+73936-0043-0201
4+2909261757-499758803+100188573+4646468-06334+74073-0049-0203
5+2913914763-600021498+10 336871+4659749-06948+74228-0055-0206
6+2918581665-700432654+100485498+4674263-07568+74403-0061-02 8
7+2923263705-80 992618+100634494+4690026-08196+74596-0068-0211
8+2927962138-901701777+100783895+4707051-08831+74808-0074-0213
00000000000000000000000000 000 000 000 000 000 000 000 000 000
2+2999880196-294980416+099882453+4770582-05235+73211-0034-0205
3+3004656218-394936116+100 28985+4781669-05853+73324-0040-0207
4+3009443947-495038467+100175760+4793997-0647 +73454-0046-0209
5+3014244632-595287728+100322813+4807582-07109+73602-0053-0212
6+3019059535-695684198+100470181+4822438-07748+73769-0059-0214
7+3023889936-796228208+10 617902+4838579-08395+73955-0065-0217
8+3028737128-896920132+100766013+4856022-09 49+74159-0071-0219
000 0000000000000 0000000 0000000 000 000 000 000 000 000 000
2+3099757380-290136828+099871883+4916385-05335+72588-0032-0211
3+3104679311-390081333+10 17161+4927689-05970+72693-0038-0213
4+3109613183-490171227+10 1626 8+4940271-06513+72817-0 4 -0215
5+3114560283-590406757+100308440+4954146-07263+72958-0050-0218
6+3119521911-690788206+100454512+4969328-07920+73117-0056-02
7+3124499380-791315893+10060 921+4985832-08585+73295-0062-02 3
8+3129494021-891990172+10 747704+5003675-09259+73491-0 68-0226
000000000000000 000 0000000 00 000000 00 000 000 000 00
2+3199623897-285148068+099861119+5060923-05428+71947-003 -0217
3+3204690464-385081165+1000 5108+5072430-06081+72045-0036-0219
4+3209769195-485158356+100149312+5085252-06742+72161-0042-0221
```

```
5+3214861410-585379873+100293766+5099402-07410+72295-0048-0224
6+3219968446-685745983+100438505+5114895-08085+72447-0054-0226
7+3225091654-786256990+100583566+5131747-08768+72617-0060-0229
8+3230232399-886913233+100728984+5149974-09460+72805-0065-0232
00000000000000000000000000000000000000000000000000000000000000
2+3299479559-280015417+099850176+5204161-05514+71280-0028-0222
3+3304689456-379936910+099992841+5215858-06185+71380-0033-0225
4+3309911724-480001166+100135706+5228905-06863+71488-0039-0227
5+3315147720-580208401+100278806+5243315-07549+71615-0045-0230
6+3320398813-680558869+100422177+5259104-08242+71759-0051-0232
7+3325661392-781052856+100565853+5276287-08943+71920-0057-0235
8+3330951858-881690688+100709870+5294832-09653+72100-0063-0238
00000000000000000000000000000000000000000000000000000000000000
2+3399324194-274740192+099839068+5346064-05593+70612-0025-0228
3+3404676080-374649899+099980374+5357937-06281+70696-0031-0231
4+3410040529-474701002+100121865+5371194-06977+70798-0037-0233
5+3415418933-574893703+100263577+5385849-07680+70917-0042-0236
6+3420812698-675228240+100405543+5401918-08391+71053-0048-0238
7+3426223245-775704885+100547799+5419417-09110+71206-0054-0241
8+3431652014-876323946+100690379+5438362-09837+71377-0060-0244
00000000000000000000000000000000000000000000000000000000000000
2+3499157644-269323745+099827809+5486598-05665+69919-0023-0234
3+3504650142-369221497+099967721+5498632-06370+69996-0028-0236
4+3510155382-469259245+100107805+5512084-07083+70090-0034-0239
5+3515674788-569437175+100248093+5526969-07803+70201-0040-0241
6+3521209803-669755510+100388620+5543302-08531+70329-0046-0244
7+3526761881-770214505+100529420+5561100-09268+70474-0051-0247
8+3532332496-870814452+100670528+5580379-10013+70637-0057-0250
00000000000000000000000000000000000000000000000000000000000000
2+3598979766-263767463+099816412+5625730-05730+69209-0020-0239
3+3604611465-363653106+099954898+5637910-06452+69279-0026-0242
4+3610256070-463677310+100093539+5651542-07181+69365-0032-0244
5+3615915039-563840248+100232370+5666641-07919+69468-0037-0247
6+3621589846-664142124+100371423+5683222-08664+69588-0043-0250
7+3627281982-764583180+100510733+5701302-09417+69725-0048-0253
8+3632992955-865163688+100650334+5720897-10180+69879-0054-0256
00000000000000000000000000000000000000000000000000000000000000
2+3698790428-258072765+099804893+5763425-05788+68483-0018-0245
3+3704559886-357946160+099941918+5775737-06526+68545-0023-0247
4+3710342397-457956649+100079084+5789534-07272+68624-0029-0250
5+3716139454-558104387+100216424+5804831-08026+68719-0034-0253
6+3721952564-658389565+100353970+5821643-08788+68830-0040-0255
7+3727783251-758812407+100491756+5839988-09558+68959-0046-0258
8+3733633056-859373169+100629816+5859882-10337+69104-0051-0261
00000000000000000000000000000000000000000000000000000000000000
2+3798589516-252241104+099793266+5899650-05838+67740-0016-0250
3+3804495255-352102127+099928798+5912080-06593+67795-0021-0253
4+3810414181-452098742+100064456+5926026-07355+67866-0026-0255
5+3816347818-552231091+100200272+5941505-08125+67953-0032-0258
6+3822297707-652499349+100336277+5958532-08904+68056-0037-0261
```

```
7+3828265404-752903721+100472506+5977125-09690+68176-0043-0264
8+3834252483-853444446+100608990+5997300-10486+68312-0048-0267
00000000000000000000000000000000000000000000000000000000000000
2+3898376928-246273965+099781545+6034375-05881+66981-0013-0256
3+3904417440-346122506+099915563+6046906-06652+67029-0018-0258
4+3910471256-446105107+100049670+6060986-07430+67091-0024-0261
5+3916539934-546221893+100183929+6076630-08216+67170-0029-0263
6+3922625044-646473023+100318362+6093856-09011+67265-0034-0266
7+3928728178-746858686+100453000+6112679-09814+67376-0040-0269
8+3934850940-847379103+100587877+6133117-10626+67503-0045-0272
00000000000000000000000000000000000000000000000000000000000000
2+3998152580-240172866+099769747+6167566-05916+66207-0011-0261
3+4004326324-340008831+099902197+6180183-06703+66246-0016-0263
4+4010513474-439977292+100034742+6194381-07497+66301-0021-0266
5+4016715618-540078357+100167413+6210175-08299+66372-0026-0269
6+4022934362-640312170+100300241+6227582-09109+66458-0031-0272
7+4029171325-740678901+100433257+6246618-09928+66560-0037-0275
8+4035428147-841178756+100566493+6267301-10756+66678-0042-0278
00000000000000000000000000000000000000000000000000000000000000
2+4097916401-233939355+099757885+6299192-05944+65417-0008-0266
3+4104221803-333762666+099888747+6311881-06746+65449-0013-0269
4+4110540699-433716877+100019689+6326181-07556+65496-0018-0271
5+4116874707-533802080+100150740+6342108-08373+65558-0023-0274
6+4123225462-634018403+100281931+6359678-09199+65636-0029-0277
7+4129594617-734365999+100413293+6378910-10034+65729-0034-0280
8+4135983842-834845056+100544857+6399820-10878+65838-0039-0283
00000000000000000000000000000000000000000000000000000000000000
2+4197668334-227575014+099745975+6429223-05965+64611-0005-0271
3+4204103792-327385607+099875219+6441967-06781+64635-0011-0274
4+4210552815-427325473+100004526+6456353-07606+64674-0016-0276
5+4217017051-527394690+100133926+6472397-08439+64728-0021-0279
6+4223498166-627593367+100263450+6490114-09280+64798-0026-0282
7+4229997843-727921641+100393127+6509523-10130+64882-0031-0285
8+4236517783-828379682+100522988+6530642-10990+64982-0036-0288
00000000000000000000000000000000000000000000000000000000000000
2+4297408339-221081452+099734032+6557627-05977+63791-0003-0276
3+4303972230-320879279+099861627+6570412-06809+63807-0008-0279
4+4310549720-420804723+099989270+6584868-07648+63838-0013-0281
5+4317142519-520857845+100116990+6601011-08496+63884-0018-0284
6+4323752311-621038738+100244816+6618359-09353+63944-0023-0287
7+4330380810-721347522+100372777+6638428-10218+64020-0028-0290
8+4337029747-821784348+100500905+6659736-11092+64110-0033-0293
00000000000000000000000000000000000000000000000000000000000000
2+4397136391-214460311+099722071+6684377-05982+62956-0000-0281
3+4403827032-314245340+099847989+6697186-06828+62964-0005-0283
4+4410531330-414156299+099973938+6711696-07683+62987-0010-0286
5+4417250995-514193235+100099947+6727922-08545+63024-0015-0289
6+4423987752-614356223+100226045+6745882-09416+63076-0020-0292
7+4430743343-714645365+100352262+6765593-10296+63143-0025-0295
8+4437519527-815060796+100478626+6787073-11185+63224-0029-0298
```

```
00000 000 000 000 000 0000000 000 000  00 0000000 0000000 000
2+4496852481-207713260+099710108+6809442-05979+62106+0002-0286
3+4503668188-307485474+099834319+6822 59-06840+62107-0003-0288
4+4510497576-407381904+099958545+6836807-07709+62122-0007-0291
5+4517342383-507402579+100082815+6853099-08585+62150-0012-0294
6+4524204362-607547558+100207157+6871154-09471+62194-0017-0297
7+4531085285-707816926+100331599+6890989-10365+62251-0022-0300
8+4537986940-808210798+100456170+6912622-11269+62323-0026-0303
0000000000000000 00000000000 000000  00 00000000000 000000
2+4596556613-200841999+099698159+6932793-05969+61243+0005-0290
3+4603495665-300601397+099820634+6945604-06844+61235+0000-0293
4+4610448406-400483268+099 43109+6960172-07726+61242-0005-0296
5+4617416601-500487624+100065611+6976514-08617+61262-0009-0298
6+4624402032-600614507+100188167+6994647-09517+61297-0014-0301
7+4631406498-700863986+100310807+7014588-10425+61345-0018-0304
8+4638431816-801236158+100433557+7036354-11343+61408-0023-0307
00000 000000000000000 00000000000 000000  000000000  0000000
00000000 0000000 000 00000000000 000000000000000000000 0000
3+4703309457-293594852+099806950+7067191-06839+60350+0003-0297
4+4710383785-393462150+099927646+7081764-07736+60348-0002-0300
5+4717473586-493450147+100048352+7098139-08640+60360-0006-0303
6+4724580669-593558866+100169095+7116332-09554+60386-0011-0306
7+4731706862-693788359+100289904+7136360-10476+60425-0015-0309
00000 000 0000000 000 000000000000000000 00000000000 00 0000
0000000000000000000 000000  0000000000000 000000 000 0000
000000 000 000 0000000000000000000000000 000000000 0000000000
3+4803109572-286467610+099793283+7186993-06827+59450+0005-0302
4+4810303694-386320339+099912172+7201555-07737+59441+0001-0305
5+4817513292-486291952+100031055+7217946-08655+59444-0003-0308
6+4824740201-586382456+100149958+7236181-09582+59461-0008-0310
7+4831986275-686591884+100268909+7256279-10518+59492-0012-0313
000000 000 000 00000000000 0000000000000000 000 000000000000000
000000 000 0000000 00000000000 000 000 0000000000000000 00000
000 0000000 00000000000000000 0000000 0000 0000000000000000000
3+4902896035-279221469+099779649+7304984-06806+58538+00 8-0306
4+4910208131-379059649+099896704+7319518-07730+58520+0004-0309
5+4917535689-479014871+100013737+7335907-08661+58515-0001-0312
6+4924880570-579087125+100130773+7354168-09601+58523-0005-0315
7+4932244654-679276428+100247839+7374318-10550+58545-0009-0318
000000 0000000 0000000 0000000 000000000000000000000000000000
0000000 000 0000000000000000 000000000000 00000000000000000 000 00
0000000000000 000000000000000 00000000000000000000000000000000
3+5002668886-271858256+099766064+7421136-06778+57612+0011-0311
4+5010097111-371681921+099881259+7435626-07714+57586+0007-0313
5+5017540765-471620761+099996416+7451997-08659+57573+00 2-0316
6+5025001738-571674749+100111559+7470266-09612+57572-0002-0319
7+5032481935-671843804+100226714+7490449-10573+57585-00 6-0322
000000000000 000 0000 00 000 000  000000 0000000 0000000 000 00
0000 000 000 000 000 000 0000000 000 000000000000000000000 00000
0000000000 00000000000 0000000 0000000 0000000000000000000000000
```

```
3+5102428183-264379820+099752543+7535423-06741+56673+0013-0315
4+5109970663-364189024+099865854+7549854-07690+56639+0009-0318
5+5117528526-464111509+099979109+7566190-08647+56 18+0005-0320
6+5125103684-564147231+100092333+7584449-09613+56609+00 1-0323
7+5132698071-664296173+100205552+7604648-10587+56612-00 3-0326
00000 000 000000000000000 000 000000000000 000 000 0000000000
0000 000 0000000000000000000000000000 000000000000000 00 000000
0000 000 000 000 000 000 000 00000000000 000 000 000 0000000 0
3+5202173999-256788039+099739103+7647821-06697+55722+0016-0319
4+5209828837-356582849+099850503+7662175-07658+55680+0012-0322
5+5217498993-456489022+099961832+7678460-08628+55650+0008-0325
6+5225186406-556506498+100073113+7696692-09606+55633+00 4-0327
7+5232893033-656635240+100184370+7716889-10592+55627-0000-0330
000000 0000000000000000000000 000 000000 0000000000 000000
000000000 000000 000000 00000000000 000 00 000 000 000 000
0000000000 0000000 0000000 000 000 000 0000000 000 000 000000
3+5301906421-249084816+099725759+7758304-06645+54759+0019-0323
4+5309671694-348865317+099835225+7772566-07618+54709+0015-0326
5+5317452206-448755237+099944603+7788783-08600+54671+0011-0329
6+5325249918-548754501+100 53916+7806971-09590+54644+0007-0331
7+5333066811-648863055+100163188+7827148-10588+54630+00 3-0334
0000000000000000000000 00000000000000000000000000000 000 0
00000 00 00000000000 000 000 000 000 000 000 000 00000000000
0000 000 000 0000000 0000000 0000000 0000000 000000000000000
3+5401625555-241272077+099712528+7866849-06585+53784+0021-0327
4+5409499317-341038368+099820036+7881003-07570+53726+0017-0330
5+5417388220-440912113+099927438+7897135-08563+53679+0014-0332
6+5425294252-540893218+100034760+7915262-09565+53644+0010-0335
7+5433219414-640981613+100142023+7935401-10575+53621+0006-0338
0000 00000000000000000000 00000000000000000000000 000000000000
00000000000000000000 000 000000000000000000000 0000000000 000 00
000000 000 000 0000000 000 000 000 00000000000000000000000000
3+5501331520-233351772+099699425+7973431-06517+52797+0024-0331
4+5509311800-333103970+099804950+7987461-07514+52731+0020-0334
5+5517307109-432961632+099910355+8003492-08519+52676+0016-0336
6+5525319457-532924648+100015662+8021541-09532+52633+0013-0339
7+5533350869-632902930+100120893+8041624-10553+52600+0009-0342
0000000 0000000000000000000000 000000000000000000 00 0000000
000000000000000 0000000000000000000000000000000000000000000000
00000000 0000000 000 0000000 000 000 00000000000000 0000000000
3+5601024453-225325876+099686465+8078028-06442+51798+0026-0335
4+5609109257-325064113+099789986+8091918-07449+51724+0023-0337
5+5617208963-424905802+099893370+8107831-08465+51662+0019-0340
6+5625325600-524850815+0999 6639+8125785-09490+51610+0 15-0343
7+5633461218-624899049+100099816+8145795-10522+51569+0012-0346
00000 0000000000 0000 000000000000000 000000 00 000 000 0000
0000000000 000 0000000000000 0000000 000000000000000 0000000 000
000 000000 00000000000000000000 000000 000 000 00 000 000000
3+5700704503-217196385+099673664+8180617-06358+50789+0029-0338
4+5708891817-316920810+099775158+8194351-07377+50707+0025-0341
```

```
5+5717093887-416746650+099876499+8210131-08404+50636+0022-0344
6+5725312766-516673764+099977709+8227972-09439+50576+0018-0346
7+5733550524-616702031+100078810+8247892-10482+50526+0015-0349
00000 00000000000 000000000000000000000000000000000000000000000
00000000000000000000000000000 00 000  00 0000000 0000000 000 000
00000000 00000000000 000 000000000000000000000000 0000 000 000000
3+5800371839-208965319+099661037+8281175-06267+49768+0032-0342
4+5808659624-308676094+099760482+8294738-07297+49679+0028-0345
5+5816962004-408486227+099859759+8310368-08335+49600+0025-0347
6+5825281055-508395563+099958889+8328082-09380+49532+0021-0350
7+5833618867-608403963+100057892+8347894-10434+49474+0018-0353
00000000 000 000 0000000 000 000000000000000000000 000000000000
00000000000000000 0000000000000000000 0000000 0000000 000 000 0
000000000 0000000000000000000000000 0000000000000000000000 0000
3+5900026641-200634719+099648599+8379682-06169+48737+0034-0345
4+5908412837-300332022+099745975+8393059-07209+48640+0031-0348
5+5916813454-400126607+099843166+8408523-08257+48553+0027-0351
6+5925230585-500018300+099940195+8426092-09313+48477+0024-0353
7+5933666344-600006949+100037080+8445779-10377+48410+0021-0356
00000 00000000 0000000000000000000000000 0000000000000000000000000
000 0000000 00000000000000 00000000000000000000000 000 000000
0000000000000000 00000000000 00000000 000000000000000 00000
3+5999669105-192206647+099636366+8476116-06063+47696+0036-0349
4+6008151634-291890672+099731651+8489291-07114+47591+0033-0351
5+6016648391-391669882+099826737+8504575-08171+47497+0030-0354
6+6025161492-491544086+099921644+8521982-09237+47412+0027-0357
7+6033693068-591513116+100016391+8541529-10311+47337+0023-0359
000000000000 0000000 0000000000000000000000 00 0000000000000 00
000000000000000000000000 0000000 000000000000000000000000000000000
00000000000000 000000  000000000000 000 000 000 0000000 000000000
3+6099299445-183683185+099624351+8570457-05950+46644+0039-0352
4+6107876205-283354142+099717526+8583416-07010+46532+0036-0355
5+6116466987-383118165+099810486+8598503-08078+46430+0032-0357
6+6125073926-482975049+099903252+8615733-09153+46337+0029-0360
7+6133699173-582924610+099995842+8635122-10237+46254+0026-0363
000000 000 000 000 0000000 0000000000000000000 000000000000000
000000 0000000 000 000000000000000000000000000 00000000000000 .00
0000000000 0000000 000000000000000000000  0000000000 000  00 000
3+6198917885-175066437+099612570+8662685-05830+45583+0041-0355
4+6207586756-274724549+099703614+8675414-06900+45464+0038-0358
5+6216269428-374473589+099794430+8690289-07977+45354+0035-0360
6+6224968055-474313339+099885036+8707326-09061+45254+0032-0363
7+6233684805-574243598+099975450+8726540-10154+45162+0029-0366
000000000000000000000000000000000000000 000000 0000000 000 000
00000000 000 00000000000000000000000000000000000 0000000 000000  00
0000000000000000000 0000000000000000 0000000000000000000000000 0
3+6298524667-166358525+099601036+8752782-05703+44512+0044-0358
4+6307283510-266004030+099689932+8765265-06782+44386+0041-0361
5+6316055918-365738308+099778585+8779913-07868+44269+0038-0363
6+6324844062-465561124+099867012+8796741-08962+44160+0035-0366
```

```
7+6333650131-565472262+099955232+8815764-10063+44061+0032-0369
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
3+6398120044-157561590+099589764+8840727-05568+43432+0046-0362
4+6406966701-257194741+099676493+8852950-06656+43299+0043-0364
5+6415826673-356914490+099762964+8867357-07751+43174+0040-0366
6+6424702148-456720589+099849195+8883961-08854+43058+0037-0369
7+6433595332-556612806+099935203+8902778-09964+42951+0034-0371
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
3+6497704286-148677793+099578768+8926504-05427+42343+0048-0364
4+6506636582-248298857+099663312+8938453-06524+42203+0045-0367
5+6515581926-348004326+099747584+8952603-07628+42071+0042-0369
6+6524542527-447793940+099831601+8968968-08739+41948+0040-0372
7+6533520606-547667450+099915380+8987563-09857+41833+0037-0374
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
3+6597277676-139709312+099568061+9010093-05279+41245+0050-0367
4+6606293416-239318568+099650403+9021755-06384+41098+0048-0370
5+6615321926-339010022+099732459+9035635-07496+40959+0045-0372
6+6624365430-438783396+099814245+9051746-08616+40829+0042-0374
7+6633426166-538638429+099895779+9070103-09743+40706+0040-0377
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
3+6696840508-130658342+099557656+9091479-05124+40139+0053-0370
4+6705937482-230256085+099637779+9102840-06238+39985+0050-0372
5+6715046933-329933800+099717603+9116435-07358+39840+0047-0375
6+6724171102-429691196+099797143+9132278-08486+39702+0045-0377
7+6733312243-529527997+099876415+9150382-09620+39572+0042-0379
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
3+6796393093-121527094+099547567+9170644-04963+39025+0055-0373
4+6805569074-221113632+099625455+9181691-06085+38864+0052-0375
5+6814757226-320777901+099703030+9194988-07213+38712+0050-0377
6+6823959804-420519594+099780308+9210548-08348+38567+0047-0380
7+6833179081-520338423+099857304+9228385-09490+38430+0045-0382
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
3+6895935753-112317799+099537807+9247572-04796+37902+0057-0375
4+6905188497-211893452+099613444+9258293-05925+37736+0054-0377
5+6914453093-311544578+099688755+9271278-07061+37577+0052-0380
6+6923731812-411270859+099763755+9286541-08203+37425+0049-0382
7+6933026939-511071990+099838459+9304096-09353+37280+0047-0384
00000000000000000000000000000000000000000000000000000000000000
```

```
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
3+6995468821-103032701+099528388+9322048-04623+36772+0059-0378
4+7004796071-202597802+099601758+9332629-05759+36600+0056-0380
5+7014134839-302236104+099674791+9345290-06902+36434+0054-0382
6+7023487414-401947275+099747499+9360243-08052+36276+0052-0384
7+7032856093-501730999+099819897+9377502-09208+36124+0049-0387
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
4+7104392126-193228954+099590411+9404686-05587+35456+0058-0382
5+7113802782-292854763+099661150+9417009-06737+35284+0056-0384
6+7123226913-392551142+099731552+9431639-07893+35119+0054-0387
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
4+7203977009-183789195+099579414+9474449-05409+34306+0060-0385
5+7213457252-283402855+099647847+9486422-06565+34128+0058-0387
6+7222950627-383084772+099715929+9500715-07729+33956+0056-0389
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
4+7303551076-174280825+099568780+9541904-05224+33149+0062-0387
5+7313098592-273882692+099634892+9553515-06388+32965+0060-0389
6+7322658884-373550490+099700643+9567459-07557+32787+0058-0391
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
4+7403114695-164706160+099558521+9607039-05034+31985+0064-0389
5+7412727157-264296602+099622300+9618276-06204+31795+0062-0391
6+7422352028-363950635+099685705+9631858-07379+31611+0060-0393
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
4+7502668246-155067526+099548647+9669839-04839+30815+0066-0391
5+7512343316-254646922+099610080+9680692-06014+30620+0064-0393
6+7522030415-354287559+099671129+9693901-07196+30430+0062-0395
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
```

```
00000000000000000000000000000000000000000000000000000000000000
4+7602212121-145367263+099539170+9730294-04638+29639+0068-0393
5+7611947446-244936004+099598246+9740750-05819+29438+0066-0395
6+7621694411-344563623+099656926+9753575-07006+29243+0064-0397
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
4+7701746721-135607723+099530100+9788391-04432+28457+0070-0395
5+7711539940-235166211+099586807+9798441-05619+28251+0068-0397
6+7721344396-334781203+099643109+9810869-06811+28051+0066-0398
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
4+7801272459-125791270+099521447+9844120-04220+27270+0071-0397
5+7811121197-225339916+099575775+9853752-05413+27059+0069-0398
6+7820980760-324942682+099629687+9865774-06610+26853+0068-0400
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
4+7900789757-115920277+099513221+9897469-04004+26078+0073-0398
5+7910691629-215459503+099565160+9906674-05202+25862+0071-0400
6+7920603906-315050455+099616672+9918279-06404+25651+0070-0402
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
4+8000299047-105997129+099505432+9948428-03784+24880+0074-0400
5+8010251659-205527367+099554972+9957197-04986+24660+0073-0401
6+8020214244-305106927+099604075+9968375-06193+24444+0071-0403
00000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000
```

```
C      THIS PROGRAM WRITES UTM ZONE TO ZONE TRANSFORMATION TABLES TO
C      DISK USING THE FORTRAN DIRECT ACCESS I/O METHOD. THE TABLES
C      COVER UTM ZONES ON THE CLARKE 1866 SPHEROID THAT SPAN THE U.S.
C      THE TABLES ARE ACCESSED WHEN THE GTGR SUBROUTINE IS CALLED TO
C      TRANSFORM UTM COORDINATES FROM ONE ZONE TO AN ADJACENT ZONE.
C
       DIMENSION B1(8,8)
       REAL*8 B1
       DEFINE FILE 3(61,512,L,IJK)
C
C      TABLES ARE CARD INPUT AND WRITTEN ON DISK.
C      CARD COLUMN ONE IS SKIPPED.
C
       DO 10 JBLOCK=1,61
       READ(5,1000) ((B1(I,J),J=1,8),I=1,8)
       WRITE(3'JBLOCK) B1
    10 CONTINUE
       IJK=1
C
C      TABLES ARE READ FROM DISK AND PRINTED.
C
       DO 20 JBLOCK=1,61
       READ(3'JBLOCK) B1
       WRITE(6,2000) ((B1(I,J),J=1,8),I=1,8)
    20 CONTINUE
  1000 FORMAT(1X,F11.3,2F10.3,F8.3,2F6.3,2F5.3)
  2000 FORMAT(1X,F12.3,2F11.3,F9.3,2F7.3,2F6.3)
       STOP
       END
```